Technical Data

Allen-Bradley

Kinetix Servo Drives Specifications

Bulletin 2071, 2093, 2094, 2097, 2098, 2099

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This document provides catalog numbers and product specifications, including performance, environmental, certifications, load force, and dimension drawings for Allen-Bradley® servo drives.

Use this publication in conjunction with the Kinetix® Motion Control Selection Guide, publication GMC-SG001, to help make decisions on the motion control products best suited for your system requirements.

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Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives

These modular safe-speed servo drives help increase productivity and protect personnel with embedded safety features. Modular design and control provides ease of maintenance and greater flexibility as the drive easily transitions from safe torque-off to safe speed.

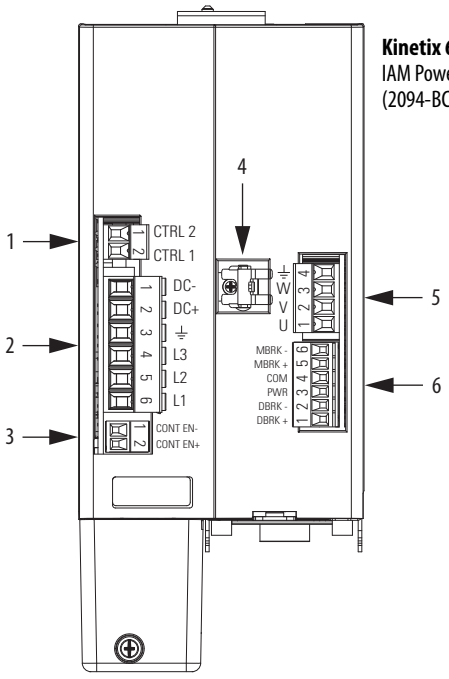
The Kinetix 6500 servo drives provide Integrated Motion on the EtherNet/IP network by using CIP Motion and CIP Sync technology from ODVA, all built on the Common Industrial Protocol (CIP).

The Kinetix 6200 servo drives provide Integrated Motion capability through the sercos interface and compatibility with Kinetix 6000 drives, letting you migrate to the enhanced features exactly when and where you need them.

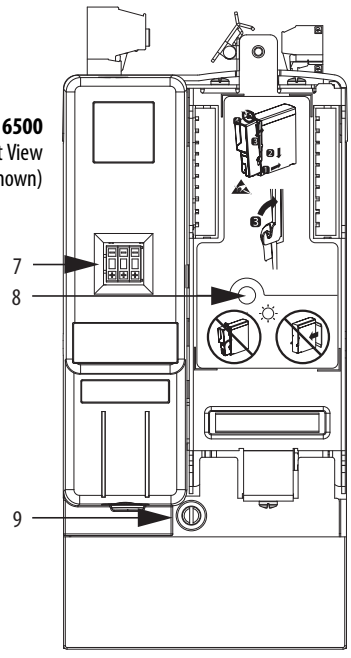
Kinetix 6200 servo drives are compatible with Kinetix 6000M integrated drive-motor systems.

Kinetix 6200 and Kinetix 6500 Drive Features and Indicators

2094-AC*xx*-M*xx*-M and 2094-BC*xx*-M*xx*-M IAM Power Module Features and Indicators



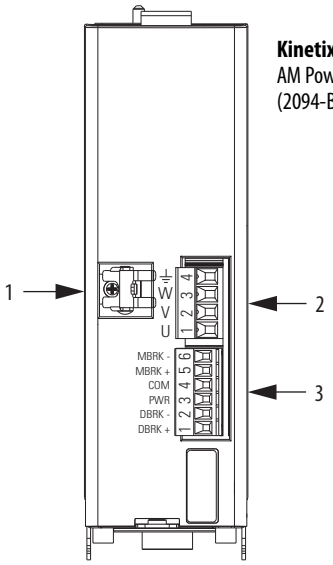
Kinetix 6200 or Kinetix 6500
IAM Power Module, Top View
(2094-BC01-MP5-M module is shown)



Kinetix 6200 or Kinetix 6500
IAM Power Module, Front View
(2094-BC01-MP5-M module is shown)

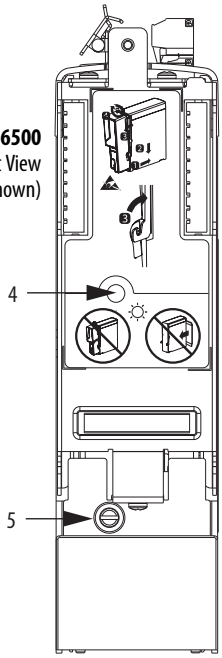
Item	Description
1	Control power (CPD) connector
2	DC bus/AC input power (IPD) connector
3	Contactor Enable (CED) connector
4	Motor cable shield clamp
5	Motor power (MP) connector
6	Motor/resistive brake (BC) connector
7	Node address switch
8	Power-applied indicator
9	Mounting screw

2094-AM*xx*-M and 2094-BM*xx*-M AM Power Module Features and Indicators



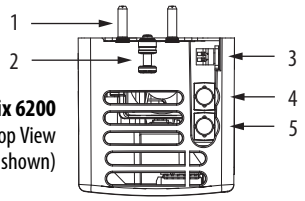
Kinetix 6200 or Kinetix 6500
AM Power Module, Top View
(2094-BMP5-M module is shown)

Kinetix 6200 or Kinetix 6500
AM Power Module, Front View
(2094-BMP5-M module is shown)



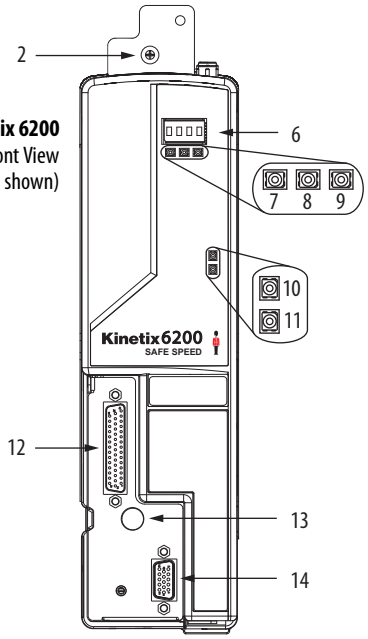
Item	Description
1	Motor cable shield clamp
2	Motor power (MP) connector
3	Motor/resistive brake (BC) connector
4	Power-applied indicator
5	Mounting screw

Control Module Features and Indicators (sercos)



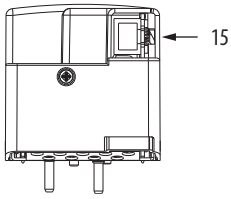
Kinetix 6200
Control Module, Top View
(2094-SE02F-M00-S1 module is shown)

Item	Description
1	Guide pins (2x)
2	Captive screw
3	Sercos communication rate and optical power switches
4	Sercos transmit (Tx) connector
5	Sercos receive (Rx) connector



Kinetix 6200
Control Module, Front View
(2094-SE02F-M00-S1 module is shown)

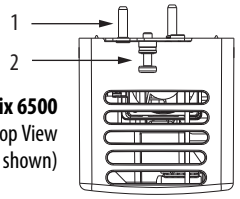
Item	Description
6	Four-character status display
7	PORT 1 status Indicator
8	Drive status indicator
9	Comm status indicator
10	DC bus status indicator
11	Safety lock status indicator (2094-SE02F-M00-S1 modules only)
12	I/O, safety, and aux feedback (IOD) connector
13	Power module mounting screw access hole
14	Motor feedback (MF) connector



Kinetix 6200
Control Module, Bottom View
(2094-SE02F-M00-S1 module is shown)

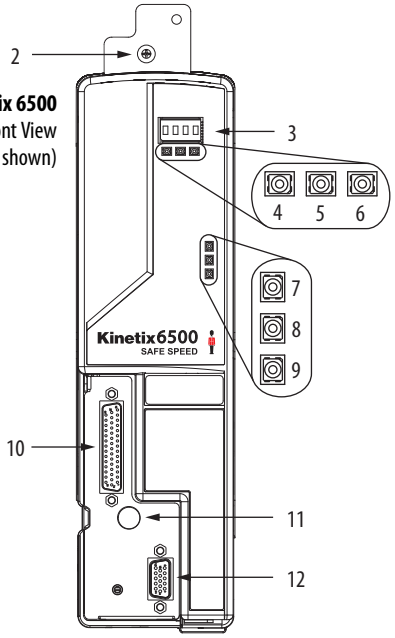
Item	Description
15	Ethernet (PORT1) connector

Control Module Features and Indicators (EtherNet/IP network)



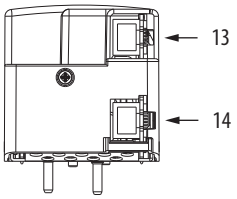
Kinetix 6500
Control Module, Top View
(2094-EN02D-M01-S1 is shown)

Item	Description
1	Guide pins (2x)
2	Captive screw



Kinetix 6500
Control Module, Front View
(2094-EN02D-M01-S1 is shown)

Item	Description
3	Four-character status display
4	PORT 1 status indicator
5	PORT 2 status indicator
6	Module status indicator
7	Network status indicator
8	DC bus status indicator
9	Safety lock status indicator (2094-EN02D-M01-S1 modules only)
10	I/O, safety, and aux feedback (IOD) connector
11	Power module mounting screw access hole
12	Motor feedback (MF) connector



Kinetix 6500
Control Module, Bottom View
(2094-EN02D-M01-S1 is shown)

Item	Description
13	Ethernet (PORT1) connector
14	Ethernet (PORT2) connector

Technical Specifications - Kinetix 6200 and Kinetix 6500 Control Modules

Control modules couple with IAM and AM power modules to provide drive status indicators and an interface to I/O, communication, functional safety, and feedback.

Features

Feature	Safe Torque-off		Safe Speed Monitoring	
	2094-EN02D-M01-S0	2094-SE02F-M00-S0	2094-EN02D-M01-S1	2094-SE02F-M00-S1
Ethernet ports	2	1	2	1
Sercos ports	–	Rx/Tx	–	Rx/Tx
DC Bus status indicator	√	√	√	√
Network status indicator	√	–	√	–
Module status indicator	√	–	√	–
Drive status indicator	–	√	–	√
Comm status indicator	–	√	–	√
Safety lock status indicator	–	–	√	√
PORT 1 status indicator	√	√	√	√
PORT 2 status indicator	√	–	√	–
IOD connector for I/O, safety, and auxiliary feedback	√	√	√	√
MF connector for motor feedback	√	√	√	√

Weight Specifications

Kinetix 6200 Control Module	Cat. No.	Weight, approx kg (lb)
Sercos interface	2094-SE02F-M00-S0	0.68 (1.5)
	2094-SE02F-M00-S1	

Kinetix 6500 Control Module	Cat. No.	Weight, approx kg (lb)
EtherNet/IP network	2094-EN02D-M01-S0	0.68 (1.5)
	2094-EN02D-M01-S1	

Technical Specifications - Kinetix 6200 and Kinetix 6500 Power Modules

IAM Module (converter, 400V-class) Power Specifications

Attribute	2094-BC01-MP5-M	2094-BC01-M01-M	2094-BC02-M02-M	2094-BC04-M03-M	2094-BC07-M05-M
AC input voltage	324…528V rms three-phase (360…480V nom)				
AC input frequency	47…63 Hz				
Main AC input current Nom (rms) Max inrush (0-pk) (1)	 10.0 A 11.0 A		 24.0 A 22.0 A	 44.0 A 31.1 A	 71.0 A 62.2 A
DC input voltage (common bus follower)	458…747V DC				
DC input current (common-bus follower)	9.0 A		22.6 A	41.5 A	67.7 A
Control power AC input voltage	95…264V rms single-phase (110…240V rms nom)				
Control power AC input current Nom (@ 220/230V AC) rms Nom (@ 110/115V AC) rms Max inrush (0-pk)	 6 A 6 A 98 A (2)				
Control power cycling, max	2 cycles per minute with a 90% on-time, 10% off-time duty cycle				
Nominal bus output voltage	650V DC				
Line loss ride through	20 ms				
Continuous output current to bus (A_{DC})	9.0 A		22.6 A	41.5 A	67.7 A
Peak output current to bus (A_{DC}) (3)	22.6 A		56.4 A	103.8 A	203.2 A
Bus overvoltage	825V DC				
Bus undervoltage	275V DC (when enabled) 425V DC (at the completion of pre-charge)				
Internal shunt Continuous power Peak power	 50 W 5.6 kW			 200W 22.5W	
Internal shunt resistor	115 Ω			27.75 Ω	
Shunt on	805V DC				
Shunt off	765V DC				
Continuous power output to bus	6 kW		15 kW	27.6 kW	45 kW
Peak power output at 480V (3)	15 kW		37.5 kW	69 kW	135 kW
Efficiency	97%				
Converter inductance	500 µH			125 µH	75 µH
Converter capacitance	110 µF		220 µF	940 µF	1410 µF
Short circuit current rating	200,000 A (rms) symmetrical				

(1) All IAM power modules are limited to 2 contactor cycles per minute (with up to 4 axes), or 1 contactor cycle per minute (with 5…8 axes). The cycle capability also depends on the converter power rating and the total system capacitance. To calculate cycle capability, refer to the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002.

(2) For eight axis systems with 230V AC control input voltage and 50 °C (122°F) ambient temperature the maximum inrush duration is less than 1/2 line cycle. To calculate the maximum inrush duration for other configurations, refer to the Kinetix 6200 and Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002.

(3) Converter peak output duration equals 400 ms with a duty cycle of 16%.

Control Power Current Requirements

Modules on Power Rail	110/115V AC Input		220/230V AC Input	
	Input Current A	**Input VA** VA	**Input Current** A	**Input VA** VA
IAM module only	0.56	67	0.36	85
IAM and 1 AM module	0.99	119	0.64	153
IAM and 2 AM module	1.43	172	0.92	220
IAM and 3 AM module	1.87	224	1.20	287
IAM and 4 AM module	2.31	277	1.48	354
IAM and 5 AM module	2.74	329	1.75	421
IAM and 6 AM module	3.18	382	2.03	488
IAM and 7 AM module	3.62	434	2.31	555
IDM power interface [1] module (IPIM)	For specifications and an example for calculating the IPIM module current requirements, refer to the Kinetix 6000M Integrated Drive-Motor User Manual, publication 2094-UM003.			

(1) For Kinetix 6000M systems, calculate the sum of the control power current requirements for each IPIM module on the power rail and add that value with the appropriate value from the table for the number of axes on the power rail.

AM Module (inverter, 400V-class) Power Specifications

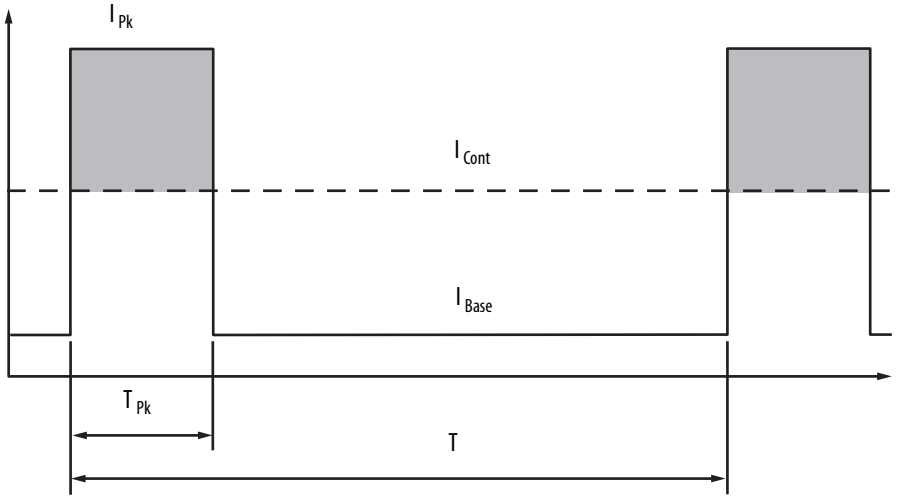
Attribute [1]	**2094-BMP5-M** (2094-BC01-MP5-M)	**2094-BM01-M** (2094-BC01-M01-M)	**2094-BM02-M** (2094-BC02-M02-M)	**2094-BM03-M** (2094-BC04-M03-M)	**2094-BM05-M** (2094-BC07-M05-M)
Bandwidth [2]					
Velocity loop	500 Hz				
Current loop	1300 Hz				
PWM frequency	8 kHz		4 kHz		
Nominal input voltage	650V DC				
Continuous current (rms) [3]	2.8 A	6.1 A	10.3 A	21.2 A	34.6 A
Continuous current (sine) 0-pk [3]	4.0 A	8.6 A	14.6 A	30.0 A	48.9 A
Peak current (rms) [3]	7.0 A	15.3 A	25.8 A	53.0 A	69.2 A
Peak current (0-pk) [3]	9.9 A	21.6 A	36.4 A	75.0 A	97.9 A
Continuous power out (nom)	1.8 kW	3.9 kW	6.6 kW	13.5 kW	22.0 kW
Internal shunt					
Continuous power	50 W			200 W	
Peak power	5.6 kW			22.5 kW	
Internal shunt resistor	115 Ω			28.75 Ω	
Shunt on	805V DC				
Shunt off	765V DC				
Efficiency	98%				
Capacitance	75 µF	150 µF	270 µF	840 µF	1175 µF
Capacitive energy absorption	10 J	19 J	35 J	108 J	152 J
Short circuit current rating	200,000 A (rms) symmetrical				

(1) These specifications apply to the axis module specified in the column heading by catalog number and the same axis module (inverter section) that resides within an IAM power module.
(2) Bandwidth values vary based on tuning parameters and mechanical components.
(3) Continuous and peak current ratings are for high-speed operation. For constant velocity operation at an electrical output frequency below 5 Hz (75 rpm for 8-pole motors), the output current rating is reduced. See Motion Analyzer software to correctly size your drive. Refer to Peak Current Specifications on page 9 for duty cycle capability.

Peak Current Specifications

Load Duty-cycle Profile Example

$$D = \frac{T_{PK}}{T} \times 100\%$$

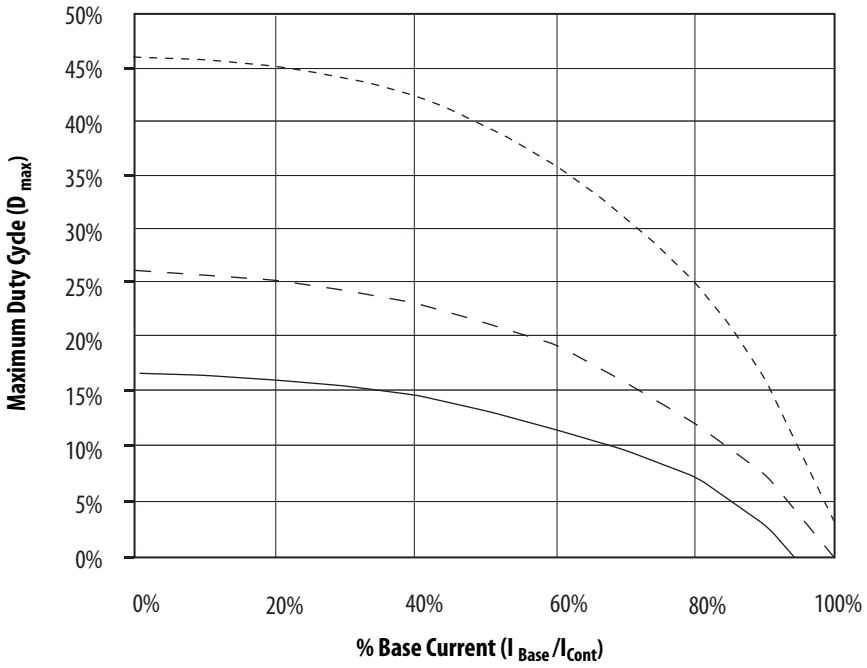


Peak Duty-cycle Definition of Terms

Term	Definition (1)
Continuous Current Rating (I_{Cont})	The maximum value of current that can be output continuously.
Peak Current Rating (I_{PKmax})	The maximum value of peak current that the drive can output. This rating is valid only for overload times less than T_{PKmax}.
Duty Cycle (D)	The ratio of time at peak to the Application Period and is defined as: $D = \frac{T_{PK}}{T} \times 100\%$
Time at Peak (T_{PK})	The time at peak current (I_{PK}) for a given loading profile. Must be less than or equal to T_{PKmax}.
Peak Current (I_{PK})	The level of peak current for a given loading profile. I_{PK} must be less than or equal to the Peak Current Rating (T_{PKMAX}) of the drive.
Base Current (I_{Base})	The level of current between the pulses of peak current for a given loading profile. I_{Base} must be less than or equal to the continuous current rating (I_{Cont}) of the drive.
Loading Profile	The loading profile is comprised of I_{PK}, I_{Base}, T_{PK}, and D (or T) values and completely specify the operation of the drive in an overload situation. These values are collectively defined as the Loading Profile of the drive.
Application Period (T)	The sum of the times at I_{PK} (T_{PK}) and I_{Base}.

(1) All current values are specified as RMS.

Peak Inverter Mode (T_{PK} < 2.0 s)



Legend (1)

I_{Pk} = 150%

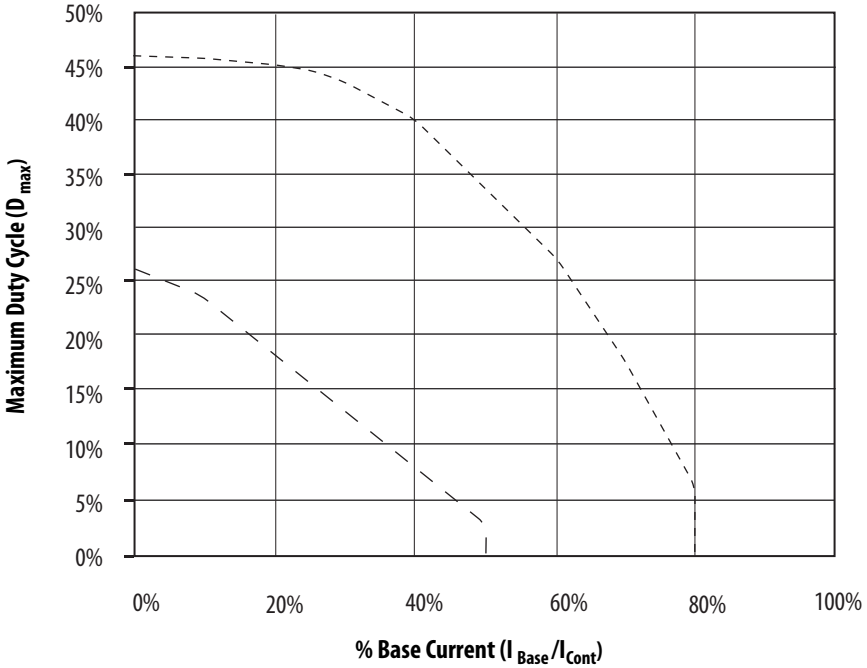
I_{Pk} = 200%

I_{Pk} = 250%

Applies to these Bulletin 2094 power modules:
2094-BC01-MP5-M, 2094-BMP5-M, 2094-BC01-M01-M, 2094-BM01-M, 2094-BC02-M02-M, 2094-BM02-M, 2094-BC04-M03-M, 2094-BM03-M

(1) Base current (I_{Base}) and peak current (I_{PK} are a percentage of the continuous drive current rating (I_{Cont}).

Peak Inverter Overload (T_{PK} < 2.0 s)



Legend (1)

I_{Pk} = 150%

I_{Pk} = 200%

Applies to these Bulletin 2094 power modules:
2094-BC07-M05-M, 2094-BM05-M

(1) Base current (I_{Base}) and peak current (I_{PK}) are a percentage of the continuous drive current rating (I_{Cont}).

Circuit Breaker/Fuse Specifications

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses. Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. Evaluation of the short-circuit available current is critical and must be kept below the short-circuit current rating of the circuit breaker.

Use class CC, J, L, or R fuses, with current rating as indicated in the table below. The following fuse examples and Allen-Bradley circuit breakers are recommended for use with 2094-BC*xx*-M*xx*-M IAM power modules when the Line Interface Module (LIM) is not used.

IMPORTANT LIM Modules (catalog numbers 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S-C*x*) provide branch circuit protection to the IAM power module. Follow all applicable NEC and local codes.

IAM Power Module Cat. No.	V AC Input Power			Control Input Power		DC Common Bus Fuse	
	Bussmann Fuse	Allen-Bradley Circuit Breaker		Bussmann Fuse (1)	Allen-Bradley (2) Circuit Breaker	Bussmann Fuse	Ferraz Shawmut Fuse
		Disconnect	Magnetic Contactor				
2094-BC01-MP5-M	KTK-R-20 (20 A)	1492-SP3D300	140M-F8E-C32	FNQ-R-10 (10 A) or FNQ-R-7.5 (7.5 A)	1492-SP2D060 or 1492-SP1D150	FWJ-20A14F	DCT20-2
2094-BC01-M01-M							
2094-BC02-M02-M	KTK-R-30 (30 A)	1492-SP3D400	140M-F8E-C45			FWJ-40A	A70QS40-4
2094-BC04-M03-M	LPJ-45SP (45 A)	N/A	140U-H6C3-C50			FWJ-70A	A70QS70-4
2094-BC07-M05-M	LPJ-80SP (80 A)		140U-H6C3-C90			FWJ-125A	A70QS125-4

(1) Use FNQ-R-7.5 fuse for higher single-cycle inrush current capability. This is recommended when the continuous control power current exceeds 3.0 A.

(2) Use 1492-SP1D150 circuit breaker for higher single-cycle inrush current capability. This is recommended when the continuous control power current exceeds 3.0 A.

Contactor Ratings

This table provides the recommended contactor ratings for IAM power modules installed without a LIM module.

IAM Power Module Cat. No.	Contactor
2094-BC01-MP5-M 2094-BC01-M01-M	100-C23x10 (AC coil) 100-C23Zx10 (DC coil)
2094-BC02-M02-M	100-C37x10 (AC coil) 100-C37Zx10 (DC coil)

IAM Power Module Cat. No.	Contactor
2094-BC04-M03-M	100-C60x10 (AC coil) 100-C60Zx10 (DC coil)
2094-BC07-M05-M	100-C72x10 (AC coil) 100-C72Zx10 (DC coil)

Input Transformer for Control Power

Attribute	Value	Cat. No. (1)
Input volt-amperes	750VA	1497B-A10-*xx-x*-N
	1000VA	1497B-A11-*xx-x*-N
	1500VA	1497B-A12-*xx-x*-N
Input voltage	460V AC	
Output voltage	120…240V AC	

(1) Variables (*xx-x*) determine the input voltage and wiring configuration.

Power Dissipation Specifications

Use this table to size an enclosure and calculate required ventilation for your Kinetix 6200 and Kinetix 6500 drive system.

Bulletin 2094 Drive Modules [1]	Usage as % of Rated Power Output (watts)				
	20%	40%	60%	80%	100%
IAM (converter) module [2]					
2094-BC01-MP5-M	18	21	25	29	34
2094-BC01-M01-M					33
2094-BC02-M02-M	36	44	54	64	75
2094-BC04-M03-M	50	67	87	110	135
2094-BC07-M05-M	71	101	137	179	226
IAM (inverter) module or AM module [2]					
2094-BC01-MP5-M or 2094-BMP5-M	46	54	61	69	77
2094-BC01-M01-M or 2094-BM01-M	57	73	90	108	126
2094-BC02-M02-M or 2094-BM02-M	53	72	93	116	142
2094-BC04-M03-M or 2094-BM03-M	94	130	169	211	255
2094-BC07-M05-M or 2094-BM05-M	121	183	252	326	407
Shunt module - 2094-BSP2	68	121	174	227	280
IPIM module - 2094-SEPM-B24-S	To calculate power dissipation for IPIM modules on your 2094 power rail, refer to the Kinetix 6000M Integrated Drive-Motor User Manual, publication 2094-UM003.				

(1) Power dissipation for the Bulletin 2094 control modules, catalog numbers 2094-SE02F-M00-S*x* and 2094-EN02D-M01-S*x*, is included in the IAM and AM power module specifications.

(2) Internal shunt power is not included in the calculations and must be added based on utilization.

Power dissipation specifications are based on these calculations. This is an example:
2094-BC02-M02-M with 4.52 A_{dc} (=20%) converter DC current and 10.3 A_{rms} (=100%) inverter output current.
Converter loss (36 W) + Inverter loss (142 W) = 178 W total power dissipation.

Weight Specifications

Bulletin 2094 Drive Modules	Cat. No.	Weight, approx kg (lb)
IAM (400V-class)	2094-BC01-MP5-M	5.67 (12.5)
	2094-BC01-M01-M	5.67 (12.5)
	2094-BC02-M02-M	5.90 (13.0)
	2094-BC04-M03-M	9.53 (21.0)
	2094-BC07-M05-M	9.98 (22.0)
Power rails (Slim)	2094-PRS1	1.05 (2.3)
	2094-PRS2	1.59 (3.5)
	2094-PRS3	2.14 (4.7)
	2094-PRS4	2.67 (5.9)
	2094-PRS5	3.11 (6.8)
	2094-PRS6	3.55 (7.8)
	2094-PRS7	3.99 (8.8)
	2094-PRS8	4.43 (9.7)

Bulletin 2094 Drive Modules	Cat. No.	Weight, approx kg (lb)
AM (400V-class)	2094-BMP5-M	3.18 (7.0)
	2094-BM01-M	3.18 (7.0)
	2094-BM02-M	3.40 (7.5)
	2094-BM03-M	5.44 (12.0)
	2094-BM05-M	5.90 (13.0)
Shunt module	2094-BSP2	3.10 (6.8)
Slot-filler module	2094-PRF	0.45 (1.0)
IPIM (400V-class)	2094-SEPM-B24-S	3.5 (7.8)

Maximum Feedback Cable Lengths

Although motor feedback cables are available in standard lengths up to 90 m (295.3 ft), the drive/motor/feedback combination may limit the maximum feedback cable length. These tables assume the use of recommended cables as shown in the Kinetix Motion Accessories Technical Data, publication GMC-TD004.

Cable Lengths for Compatible Rotary Motors

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)
MPL-B15*xxx*… MPL-B2*xxx*-E/V		90 (295.3)	
MPL-B3*xxx*… MPL-B5*xxx*-S/M		90 (295.3)	
MPL-B15*xxx*… MPL-B45*xxx*-H			30 (98.4)
MPM-B*xxxxx*-S/M		90 (295.3)	
MPF-B*xxxx*-S/M		90 (295.3)	
MPS-B*xxxx*-S/M		90 (295.3)	
RDB-B215*xx*-7/3	30 (98.4)		
RDB-B290*xx*-7/3 or RDB-B410*xx*-7/3	90 (295.3)		

Cable Lengths for Compatible Linear Actuators

Actuator Cat. No.	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)
MPMA-B*xxxxx* or MPAS-B*xxxxx*-V (ballscrew)	90 (295.3)	
MPMA-B*xxxxx* or MPAS-B*xxxxx*-A (direct drive)		30 (98.4)
MPAR-B*xxxxx*-V/M	90 (295.3)	
MPAI-B*xxxxx*M3	90 (295.3)	

Cable Lengths for Compatible Linear Motors

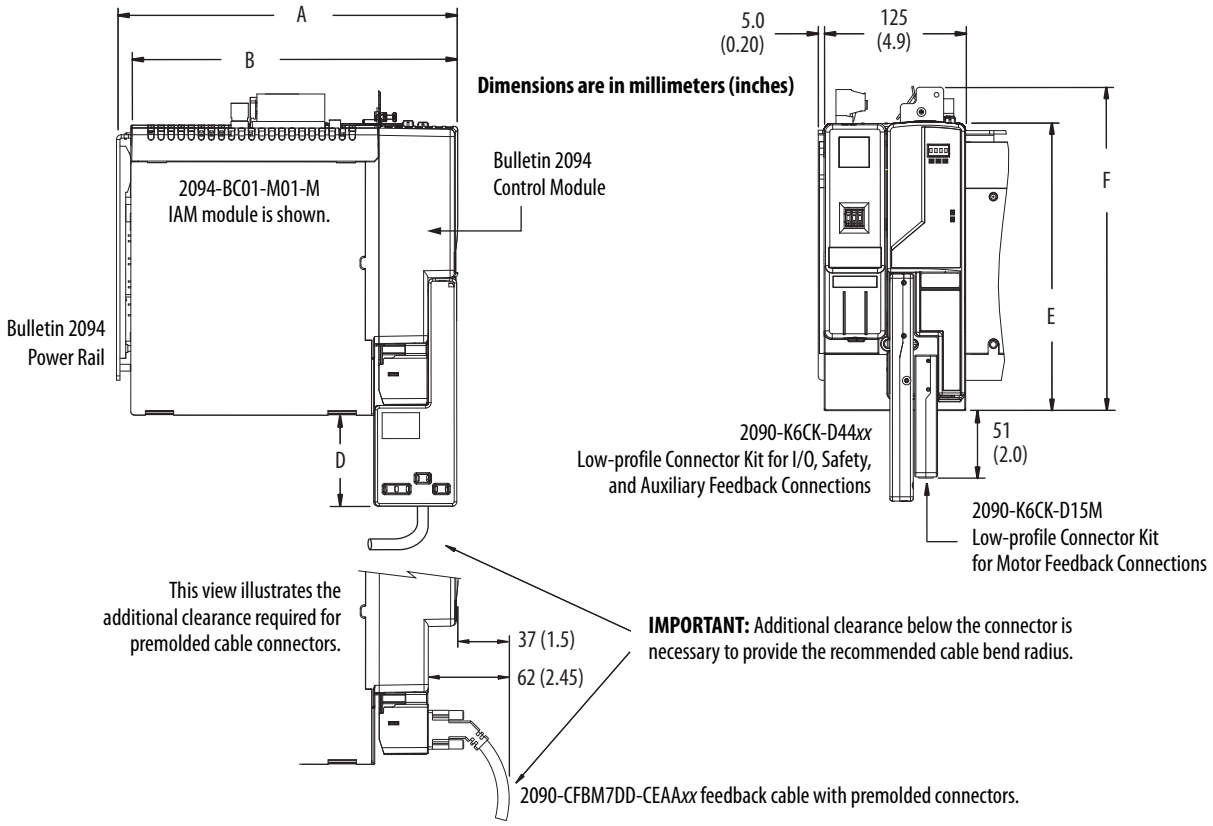
Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)
LDC-Series™	30 (98.4)	30 (98.4)

Maximum Power Cable Length

Although motor power cables are available in standard lengths up to 90 m (295.3 ft) and the Kinetix 6000 power rail is available in sizes up to eight axes, to meet CE requirements and improve system performance the combined motor power length for all axes on the same DC bus must not exceed 240 m (787 ft) for 400V-class systems.

Dimensions - Kinetix 6200 and Kinetix 6500 Modular Servo Drives

2094-BC01-MP5-M, 2094-BC01-M01-M, and 2094-BC02-M02-M IAM Modules

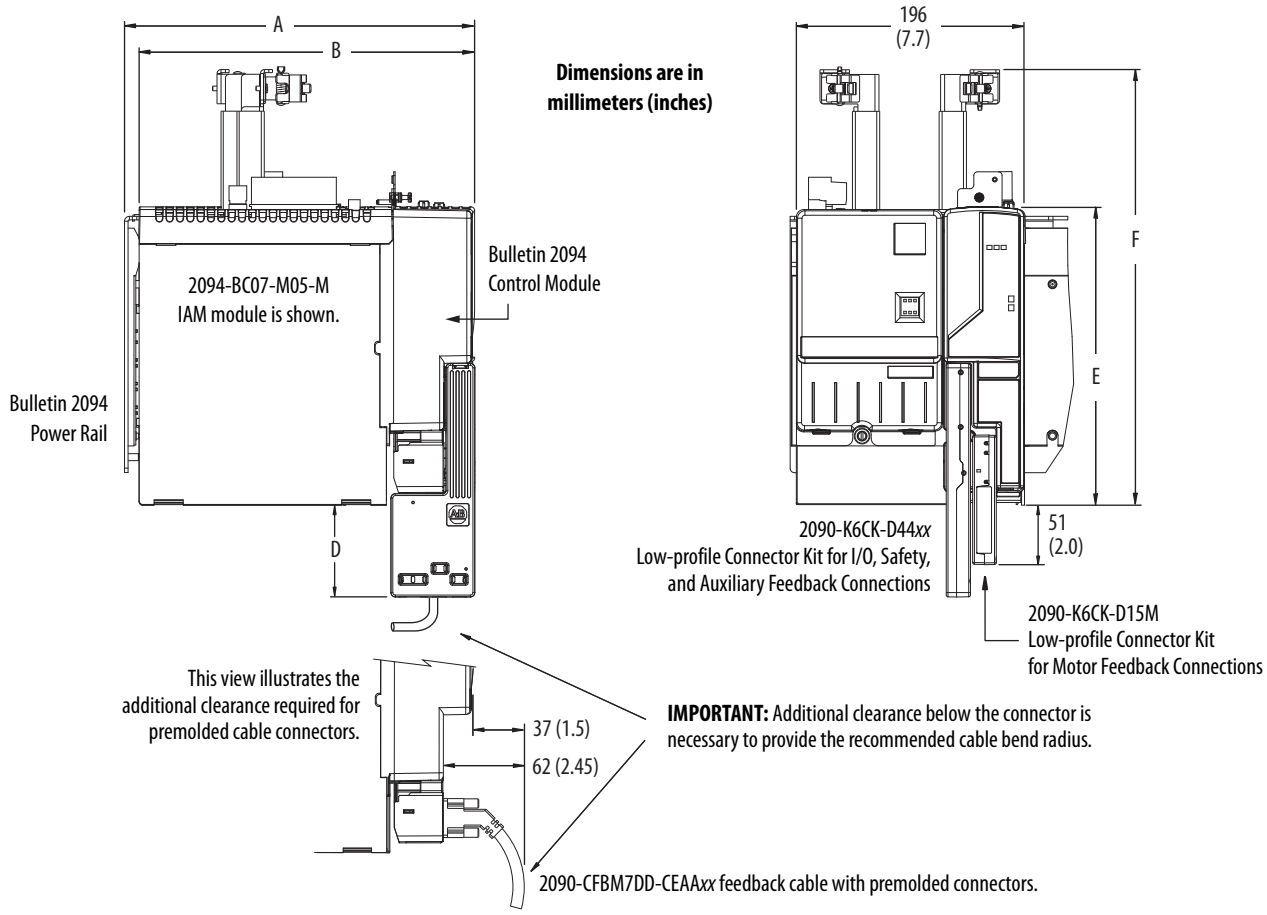


The IAM power module is shown mounted to the power rail with the control module attached.

IAM Power Module Dimensions

IAM Power Module Cat. No.	A mm (in.)	B mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)
2094-BC01-MP5-M	302 (11.9)	290 (11.4)	80.0 (3.2)	260 (10.25)	285 (11.2)
2094-BC01-M01-M					
2094-BC02-M02-M					

2094-BC04-M03-M and 2094-BC07-M05-M IAM Modules

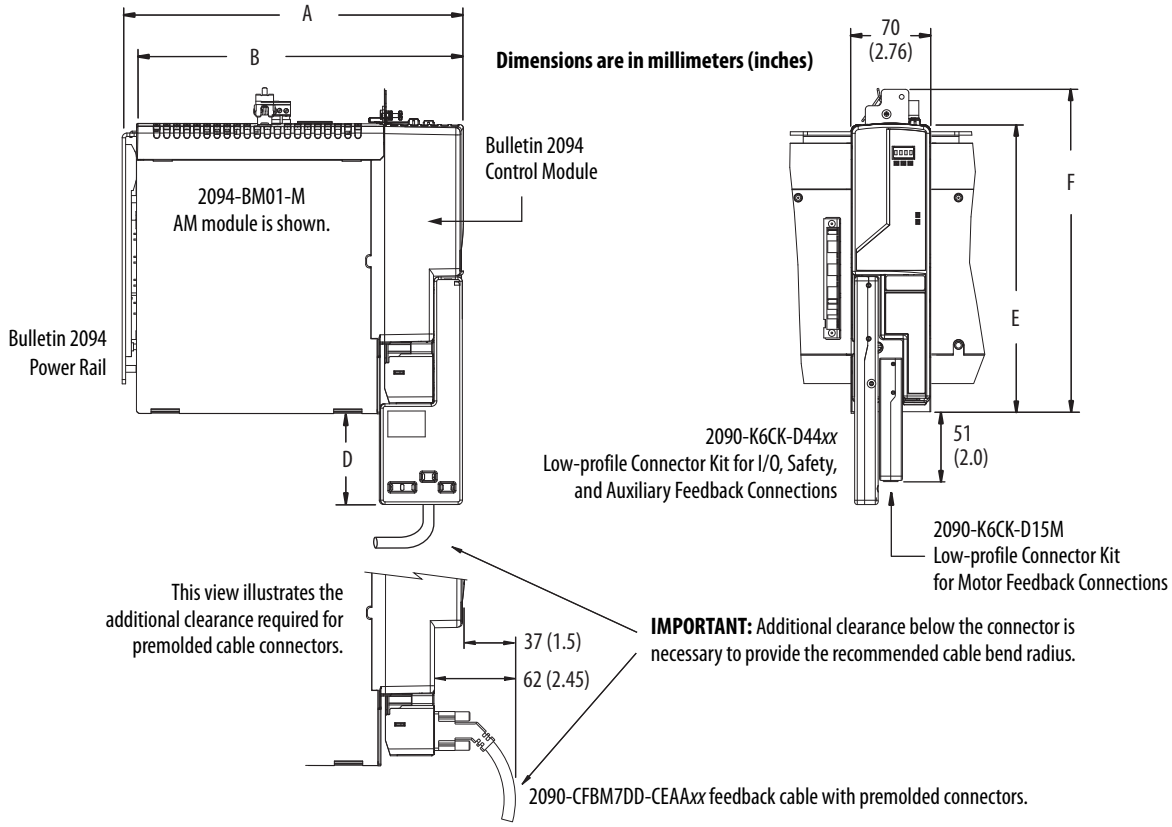


The IAM power module is shown mounted to the power rail with the control module attached.

IAM Power Module Dimensions

IAM Power Module Cat. No.	A mm (in.)	B mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)
2094-BC04-M03-M	302 (11.9)	290 (11.4)	80 (3.1)	260 (10.25)	375 (14.7)
2094-BC07-M05-M					

2094-BMP5-M, 2094-BM01-M, and 2094-BM02-M AM Modules

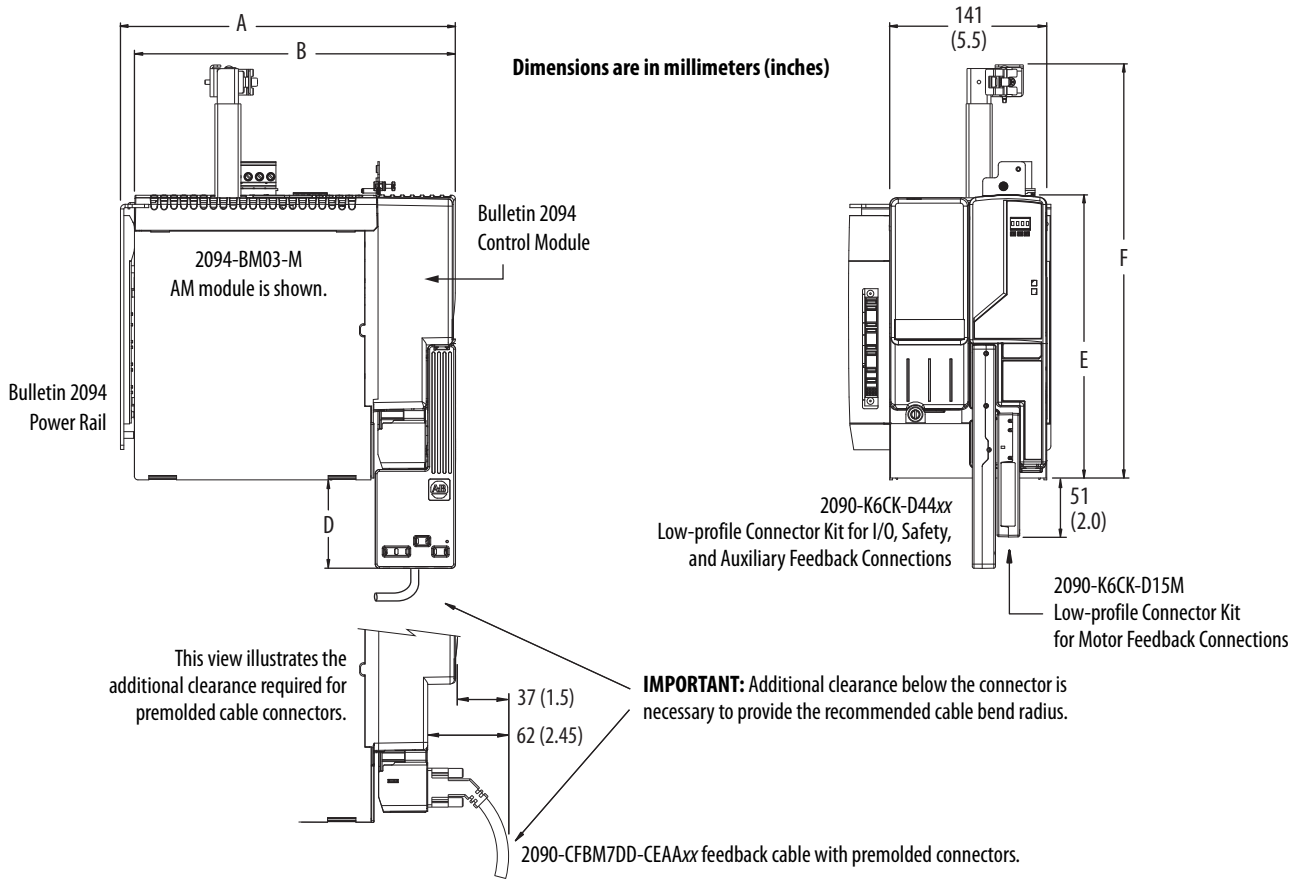


The AM power module is shown mounted to the power rail with the control module attached.

AM Power Module Dimensions

AM Power Module Cat. No.	A mm (in.)	B mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)
2094-BMP5-M	302 (11.9)	290 (11.4)	80.0 (3.2)	260 (10.25)	285 (11.2)
2094-BM01-M					
2094-BM02-M					

2094-BM03-M and 2094-BM05-M AM Modules



The AM power module is shown mounted to the power rail with the control module attached.

AM Power Module Dimensions

AM Power Module Cat. No.	A mm (in.)	B mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)
2094-BM03-M	302 (11.9)	290 (11.4)	80 (3.1)	260 (10.25)	375 (14.7)
2094-BM05-M					

Environmental Specifications - Kinetix 6200 and Kinetix 6500 Modular Servo Drives

Attribute	Operational Range	Storage Range (nonoperating)
Temperature, ambient	0…50 °C (32…122 °F)	-40…70 °C (-40…158 °F)
Relative humidity	5…95% noncondensing	5…95% noncondensing
Altitude	1000 m (3281 ft) 3000 m (9843 ft) with derating	3000 m (9843 ft) during transport
Vibration	5…55 Hz @ 0.35 mm (0.014 in.) double amplitude, continuous displacement; 55…500 Hz @ 2.0 g peak constant acceleration (10 sweeps in each of 3 mutually perpendicular directions)	
Shock	15 g, 11 ms half-sine pulse (3 pulses in each direction of 3 mutually perpendicular directions)	

Certifications - Kinetix 6200 and Kinetix 6500 Modular Servo Drives

Agency Certification (1)	Standards
c-UL-us (2)	UL Listed to U.S. and Canadian safety standards (UL 508C File E59272).
	Solid-state motor overload protection provides dynamic fold-back of motor current when 110% of the motor rating is reached with a peak current limit based on the peak rating of the motor as investigated by UL to comply with UL 508C (UL File E59272, volume 1, section 22).
CE	European Union 2004/108/EC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC requirements and specific test methods.
	European Union 2006/95/EC Low Voltage Directive compliant with: • EN 61800-5-1:2007 - Adjustable speed electrical power drive systems. • EN 50178:1997 - Electronic Equipment for use in Power Installations.
Functional Safety	TÜV Certified for Functional Safety: up to SIL CL3, according to EN 61800-5-2, EN 61508, and EN 62061; up to Performance Level PLe and Category 4, according to EN ISO 13849-1; when used as described in the Kinetix 6200 and Kinetix 6500 Safe Speed Monitoring Safety Reference Manual, publication 2094-RM001, and the Kinetix 6200 and Kinetix 6500 Safe Torque-off Safety Reference Manual, publication 2094-RM002.
C-Tick	Australian Radio Communications Act, compliant with: • Radio Communications Act: 1992 • Radio Communications (Electromagnetic Compatibility) Standard: 1998 • Radio Communications (Compliance Labelling - Incidental Emissions) Notice: 1998 • AS/NZS CISPR 11: 2003 (Group 2, Class A)
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3 • Registration number: KCC-REM-RAA-2094

(1) When product is marked, refer to http://www.ab.com for Declarations of Conformity Certificates.

(2) Underwriters Laboratories Inc. has not evaluated the safe-off, safe torque-off, or safe speed-monitoring options in these products.

Kinetix 6000 Multi-axis Servo Drives

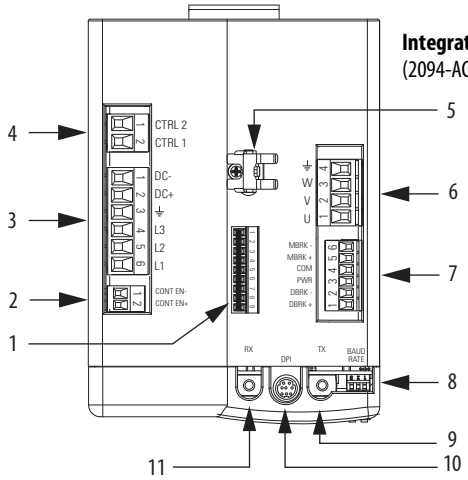
The Kinetix 6000 multi-axis servo drives provide powerful simplicity to handle even the most demanding applications quickly, easily, and cost-effectively. By providing advanced control capability along with innovative design and installation features, the Kinetix 6000 drives significantly improve system performance while saving time and money. The compact size, simplified wiring, and easy-to-use components make the Kinetix 6000 drives an ideal choice for both OEMs and end-users. Target applications for the Kinetix 6000 drives include packaging, material handling, converting, and assembly.

The Kinetix 6000 servo drives provide Integrated Motion capability through sercos interface and compatibility with Kinetix 6200 drives, letting you migrate to the enhanced features exactly when and where you need them.

Kinetix 6000 servo drives are compatible with Kinetix 6000M integrated drive-motor systems.

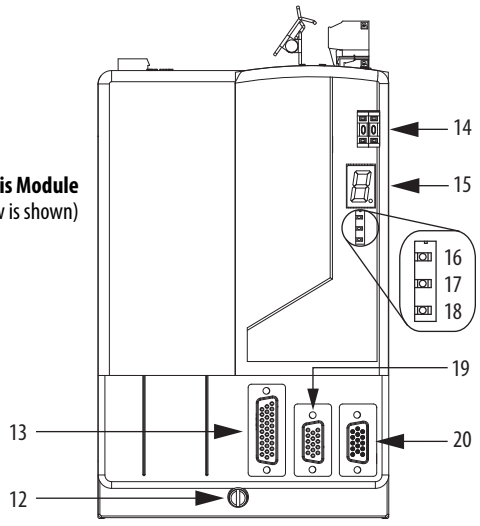
Kinetix 6000 Drive Features and Indicators

2094-AC*xx*-M*xx*-S and 2094-BC*xx*-M*xx*-S IAM Features and Indicators



Integrated Axis Module
(2094-AC05-M01-S top view is shown)

Integrated Axis Module
(2094-AC05-M01-S front view is shown)



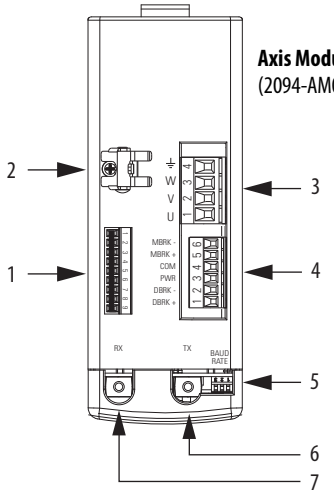
Item	Description
1	Safe-off (SO) connector
2	Contactor enable (CED) connector
3	DC bus/AC input power (IPD) connector
4	Control power (CPD) connector
5	Motor cable shield clamp
6	Motor power (MP) connector
7	Motor/resistive brake (BC) connector

Item	Description
8	Sercos communication rate and optical power switches
9	Sercos transmit (Tx) connector
10	DPI connector
11	Sercos receive (Rx) connector
12	Mounting screw
13	I/O (IOD) connector
14	Sercos node address switch

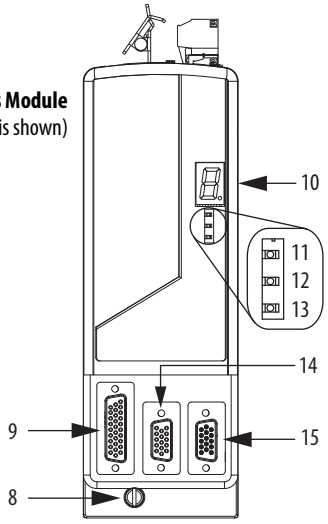
Item	Description
15	Seven-segment fault status indicator
16	Drive status indicator
17	COMM status indicator
18	Bus status indicator
19	Motor feedback (MF) connector
20	Auxiliary feedback (AF) connector

2094-AM*xx*-S and 2094-BM*xx*-S AM Features and Indicators

Axis Module
(2094-AM01-S top view is shown)



Axis Module
(2094-AM01-S front view is shown)



Item	Description
1	Safe-off (SO) connector
2	Motor cable shield clamp
3	Motor power (MP) connector
4	Motor/resistive brake (BC) connector
5	Sercos communication rate and optical power switches

Item	Description
6	Sercos transmit (Tx) connector
7	Sercos receive (Rx) connector
8	Mounting screw
9	I/O (IOD) connector
10	Seven-segment fault status indicator

Item	Description
11	Drive status indicator
12	COMM status indicator
13	Bus status indicator
14	Motor feedback (MF) connector
15	Auxiliary feedback (AF) connector

Technical Specifications - Kinetix 6000 Multi-axis Servo Drives

IAM Module (converter, 200V-class) Power Specifications

Attribute	2094-AC05-MP5-S	2094-AC05-M01-S	2094-AC09-M02-S	2094-AC16-M03-S	2094-AC32-M05-S
AC input voltage	195…264V rms, three-phase (230V nom)				
AC input frequency	47…63 Hz				
Main AC input current Nom (rms) Max inrush (0-pk) (1)	 10 A 19 A		 19 A 37 A	 36 A 73 A	 71 A 138 A
DC input voltage (common-bus follower)	275…375V DC				
DC input current (common-bus follower)	10 A		19 A	36 A	71 A
Control power AC input voltage	95…264V rms, single-phase (110…240V nom)				
Control power AC input current Nom (@ 220/230V AC) rms Nom (@ 110/115V AC) rms Max inrush (0-pk)	 3 A 6 A 20 A			 3 A 6 A 83 A (2)	
Nominal bus output voltage	325V DC				
Line loss ride through	20 ms				
Continuous output current to bus (A_{DC})	10 A		19 A	36 A	71 A
Peak output current to bus (A_{DC}) (3)	20 A		38 A	72 A	142 A
Bus overvoltage	415V DC				
Bus undervoltage	138V DC				
Internal shunt Continuous power Peak power	 N/A N/A		 50 W 8200 W	 200 W 5700 W	 200 W 5700 W
Internal shunt resistor	N/A		20 Ω	28.75 Ω	28.75 Ω
Shunt on	N/A		405V DC		
Shunt off	N/A		375V DC		
Continuous power output to bus	3 kW		6 kW	11.3 kW	22.5 kW
Peak power output	6 kW		12 kW	22.6 kW	45.0 kW
Efficiency	95%				
Converter inductance	N/A			150 µH	75 µH
Converter capacitance	270 µF		540 µF	1320 µF	1980 µF
Short circuit current rating	200,000 A (rms) symmetrical				

(1) All 2094-*xCxx* IAM modules are limited to 2 contactor cycles per minute (with up to 4 axes), or 1 contactor cycle per minute (with 5…8 axes). The cycle capability also depends on the converter power rating and the total system capacitance. To calculate cycle capability, refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001.

(2) For eight axis systems with 230V AC control input voltage and 50 °C (122°F) ambient temperature the maximum inrush duration is less than 1/2 line cycle. To calculate the maximum inrush duration for other configurations, refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001.

(3) Peak output current duration equals 250 ms.

IAM Module (converter, 400V-class) Power Specifications (series A and B)

Attribute	2094-BC01-MP5-S	2094-BC01-M01-S	2094-BC02-M02-S	2094-BC04-M03-S	2094-BC07-M05-S
AC input voltage	324…528V rms three-phase (360…480V nom)				
AC input frequency	47…63 Hz				
Main AC input current Nom (rms) Max inrush (0-pk) (1)	 10.0 A 11.0 A		 24.0 A 22.0 A	 44.0 A 31.1 A	 71.0 A 62.2 A
DC input voltage (common bus follower)	458…747V DC				
DC input current (common-bus follower)	9.0 A		22.6 A	41.5 A	67.7 A
Control power AC input voltage	95…264V rms single-phase (110…240V rms nom)				
Control power AC input current Nom (@ 220/230V AC) rms Nom (@ 110/115V AC) rms Max inrush (0-pk)	 6 A 6 A 98 A (2)				
Control power cycling, max	2 cycles per minute with a 90% on-time, 10% off-time duty cycle				
Nominal bus output voltage	650V DC				
Line loss ride through	20 ms				
Continuous output current to bus (A_{DC})	9.0 A		22.6 A	41.5 A	67.7 A
Peak output current to bus (A_{DC}) Series A drives (3) Series B drives	 18.1 A 22.6 A (4)		 45.2 A 56.4 A (4)	 83.1 A 103.8 A (4)	 135.4 A 203.2 A (5)
Bus overvoltage	825V DC				
Bus undervoltage	275V DC				
Internal shunt Continuous power Peak power	 50 W 5.6 kW			 200 W 22.5 kW	
Internal shunt resistor	115 Ω			28.75 Ω	
Shunt on	805V DC				
Shunt off	755V DC				
Continuous power output to bus	6 kW		15 kW	27.6 kW	45 kW
Peak power output Series A drives (3) Series B drives	 12 kW 15 kW (4)		 30 kW 37.5 kW (4)	 55.2 kW 69 kW (4)	 90 kW 135 kW (5)
Efficiency	97%				
Converter inductance	500 µH			125 µH	75 µH
Converter capacitance	110 µF		220 µF	940 µF	1410 µF
Short circuit current rating	200,000 A (rms) symmetrical				

(1) All 2094-*xCxx* IAM modules are limited to 2 contactor cycles per minute (with up to 4 axis modules), or 1 contactor cycle per minute (with 5 to 8 axis modules). The cycle capability also depends on the converter power rating and the total system capacitance. Refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001 when making calculations.

(2) For eight axis systems with 230V AC control input voltage and 50 °C (122°F) ambient temperature the maximum inrush duration is less than 1/2 line cycle. To calculate the maximum inrush duration for other configurations, refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001.

(3) Peak output current duration equals 250 ms.

(4) Converter peak output duration equals 400 ms with a duty cycle of 16%.

(5) Converter peak output duration equals 200 ms with a duty cycle of 3%.

Control Power Current Requirements

Modules on Power Rail	110/115V AC Input		220/230V AC Input	
	Input Current A	**Input VA** VA	**Input Current** A	**Input VA** VA
IAM module only	0.56	67	0.36	85
IAM and 1 AM module	0.99	119	0.64	153
IAM and 2 AM module	1.43	172	0.92	220
IAM and 3 AM module	1.87	224	1.20	287
IAM and 4 AM module	2.31	277	1.48	354
IAM and 5 AM module	2.74	329	1.75	421
IAM and 6 AM module	3.18	382	2.03	488
IAM and 7 AM module	3.62	434	2.31	555
IDM power interface [1] module (IPIM)	For specifications and an example for calculating the IPIM module current requirements, refer to the Kinetix 6000M Integrated Drive-Motor User Manual, publication 2094-UM003.			

(1) For Kinetix 6000M systems, calculate the sum of the control power current requirements for each IPIM module on the power rail and add that value with the appropriate value from the table for the number of axes on the power rail.

AM Module (inverter, 200V-class) Power Specifications

Attribute [1]	**2094-AMP5-S (2094-AC05-MP5-S)**	**2094-AM01-S (2094-AC05-M01-S)**	**2094-AM02-S (2094-AC09-M02-S)**	**2094-AM03-S (2094-AC16-M03-S)**	**2094-AM05-S (2094-AC32-M05-S)**
Bandwidth [2]					
Velocity loop	500 Hz				
Current loop	1300 Hz				
PWM frequency	8 kHz		4 kHz		
Input voltage (nom)	325V DC				
Continuous current (rms)	3.7 A	6.0 A	10.6 A	17.3 A	34.6 A
Continuous current (0-pk)	5.2 A	8.5 A	15.0 A	24.5 A	48.9 A
Peak current (rms) [3]	7.4 A	12.0 A	21.2 A	34.6 A	51.9 A
Peak current (0-pk) [3]	10.5 A	17.0 A	30.0 A	48.9 A	73.4 A
Continuous power out (nom)	1.2 kW	1.9 kW	3.4 kW	5.5 kW	11.0 kW
Internal shunt					
Continuous power	N/A			50 W	
Peak power	N/A			1400 W	
Internal shunt resistor	N/A			115 Ω	
Shunt on	N/A			405V DC	
Shunt off	N/A			375V DC	
Efficiency	98%				
Capacitance	390 µF	660 µF	780 µF	1320 µF	2640 µF
Capacitive energy absorption	15 J	25 J	29 J	50 J	99 J
Short circuit current rating	200,000 A (rms) symmetrical				

(1) These specifications apply to the axis module specified in the column heading by catalog number and the same axis module (inverter section) that resides within an IAM power module.
(2) Bandwidth values vary based on tuning parameters and mechanical components.
(3) Peak current duration equals 2.5 seconds.

IMPORTANT The peak current ratings of the Kinetix 6000 AM modules (series A and B) are configured at the factory as 150% of continuous current. You can program 2094-BMP5-S, 2094-BM01-S, 2094-BM02-S, and 2094-BM03-S series-B drives and their equivalent IAM (inverter) modules, up to 250% of continuous inverter current. You can program the 2094-BM05-S (AM module) and the 2094-BC07-M05-S (inverter) module up to 200% of continuous inverter current.

AM Module (inverter, 400V-class) Power Specifications (series A and B)

Attribute	2094-BMP5-S (2094-BC01-MP5-S)	2094-BM01-S (2094-BC01-M01-S)	2094-BM02-S (2094-BC02-M02-S)	2094-BM03-S (2094-BC04-M03-S)	2094-BM05-S (2094-BC07-M05-S)
Bandwidth (1)					
Velocity loop	500 Hz				
Current loop	1300 Hz				
PWM frequency	8 kHz		4 kHz		
Nominal input voltage	650V DC				
Continuous current (rms) (2)	2.8 A	6.1 A	10.3 A	21.2 A	34.6 A
Continuous current (sine) 0-pk (3)	4.0 A	8.6 A	14.6 A	30.0 A	48.9 A
Peak current (rms) (3)					
Series A drives	4.2 A	9.2 A	15.5 A	31.8 A	51.9 A
Series B drives (3)	7.0 A	15.3 A	25.8 A	53.0 A	69.2 A
Peak current (0-pk) (3)					
Series A drives	5.9 A	12.9 A	21.8 A	45.0 A	73.4 A
Series B drives (3)	9.9 A	21.6 A	36.4 A	75.0 A	97.9 A
Continuous power out, nom	1.8 kW	3.9 kW	6.6 kW	13.5 kW	22.0 kW
Internal shunt					
Continuous power	50 W			200 W	
Peak power	5.6 kW			22.5 kW	
Internal shunt resistor	115 Ω			28.75 Ω	
Shunt on	805V DC				
Shunt off	755V DC				
Efficiency	98%				
Capacitance	75 µF	150 µF	270 µF	840 µF	1175 µF
Capacitive energy absorption	10 J	19 J	35 J	108 J	152 J
Short circuit current rating	200,000 A (rms) symmetrical				

(1) Bandwidth values vary based on tuning parameters and mechanical components.

(2) Continuous and peak current ratings are for high-speed operation. For constant velocity operation at an electrical output frequency below 5 Hz (75 rpm for 8-pole motors), the output current rating is reduced. See Motion Analyzer software to correctly size your drive.

(3) Applies to series-B drives when configured for Peak-enhanced mode. For more information on drive performance in the Peak-enhanced mode, refer to Peak Enhancement Specifications on page 25.

Peak Enhancement Specifications

Drives that support the Peak-enhanced mode have the capability of increasing the maximum inverter peak current to achieve greater overload performance.

IMPORTANT The peak enhancement feature requires the use of RSLogix™ 5000 software and drive firmware as specified below.

Peak Enhancement Software and Firmware Requirements

IAM Module Cat. No.	AM Module Cat. No.	RSLogix 5000 Software Version	Kinetix 6000 Drive Firmware Revision
2094-BC01-MP5-S	2094-BMP5-S	16 or later	1.111 or later
2094-BC01-M01-S	2094-BM01-S	16 or later	1.111 or later
2094-BC02-M02-S	2094-BM02-S	16 or later	1.111 or later
2094-BC04-M03-S	2094-BM03-S	17 or later	1.117 or later
2094-BC07-M05-S	2094-BM05-S	17 or later	1.117 or later

Kinetix 6000 Peak Overload Support

IAM/AM Module Cat. No.	Module	Safe-off Drive	Series A	Series B
2094-BC*xx*-M*xx*	IAM	Non safe-off	Standard	Standard
2094-BM*xx*	AM			
2094-BC*xx*-M*xx*-S	IAM	Safe-off	Standard	Standard or Peak enhanced (1)
2094-BM*xx*-S	AM			

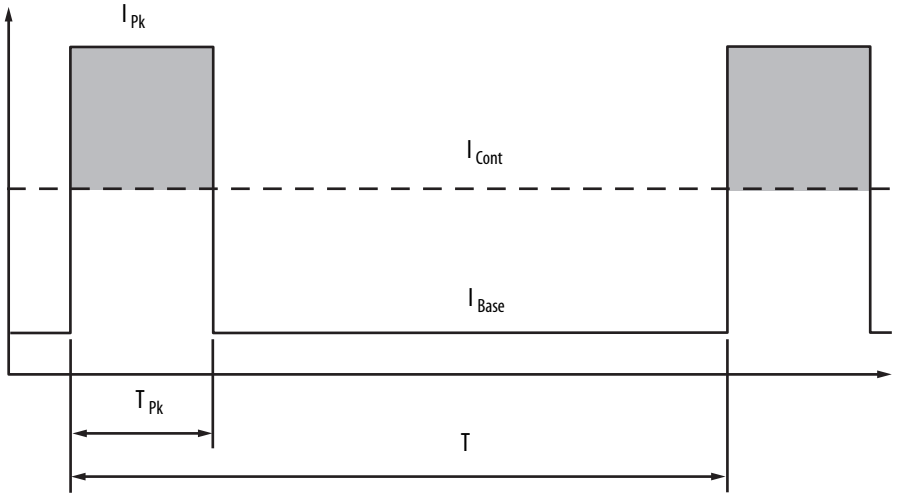
(1) Standard mode is enabled by default to preserve backward compatibility, but you can enable the Peak-enhanced mode to achieve increased peak current performance. Refer to the Kinetix 6000 Multi-axis Servo Drives User Manual, publication 2094-UM001, for information on enabling the Peak-enhanced mode.

Kinetix 6000 Peak Current Ratings

IAM/AM Module Cat. No.	Peak Inverter Current Rating		Peak Converter Current Rating	
	Standard	Peak Enhanced	Series A	Series B
2094-BC01-MP5-S	150%	250%	200%	250%
2094-BC01-M01-S	150%	250%	200%	250%
2094-BC02-M02-S	150%	250%	200%	250%
2094-BC04-M03-S	150%	250%	200%	250%
2094-BC07-M05-S	150%	200%	200%	300%
2094-BMP5-S	150%	250%	N/A	N/A
2094-BM01-S	150%	250%	N/A	N/A
2094-BM02-S	150%	250%	N/A	N/A
2094-BM03-S	150%	250%	N/A	N/A
2094-BM05-S	150%	200%	N/A	N/A

Load Duty-cycle Profile Example

$$D = \frac{T_{PK}}{T} \times 100\%$$

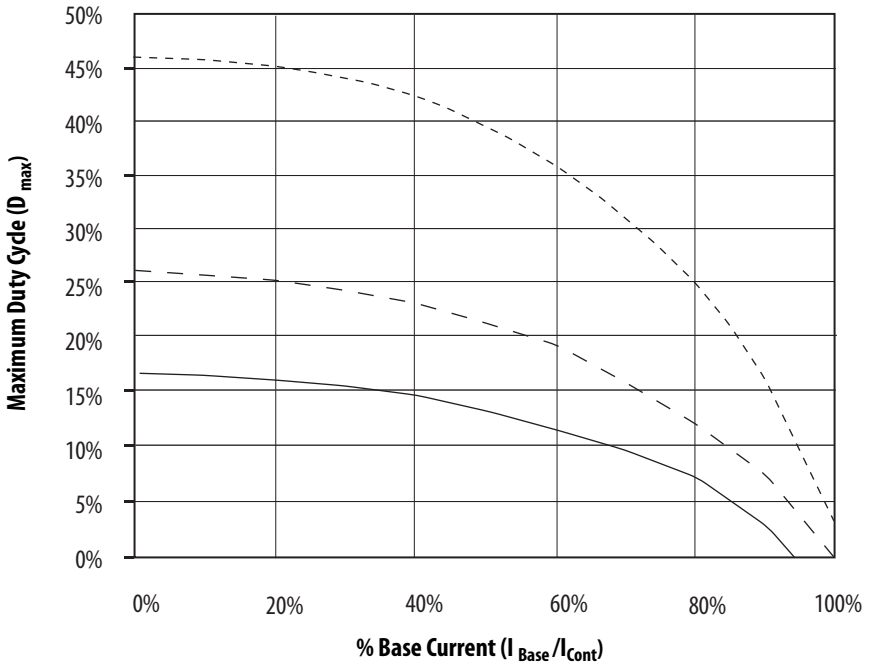


Peak Duty-cycle Definition of Terms

Term	Definition (1)
Continuous Current Rating (I_{Cont})	The maximum value of current that can be output continuously.
Peak Current Rating (I_{PKmax})	The maximum value of peak current that the drive can output. This rating is valid only for overload times less than T_{PKmax}.
Duty Cycle (D)	The ratio of time at peak to the Application Period and is defined as: $D = \frac{T_{PK}}{T} \times 100\%$
Time at Peak (T_{PK})	The time at peak current (I_{PK}) for a given loading profile. Must be less than or equal to T_{PKmax}.
Peak Current (I_{PK})	The level of peak current for a given loading profile. I_{PK} must be less than or equal to the Peak Current Rating (T_{PKMAX}) of the drive.
Base Current (I_{Base})	The level of current between the pulses of peak current for a given loading profile. I_{Base} must be less than or equal to the continuous current rating (I_{Cont}) of the drive.
Loading Profile	The loading profile is comprised of I_{PK}, I_{Base}, T_{PK}, and D (or T) values and completely specify the operation of the drive in an overload situation. These values are collectively defined as the Loading Profile of the drive.
Application Period (T)	The sum of the times at I_{PK} (T_{PK}) and I_{Base}.

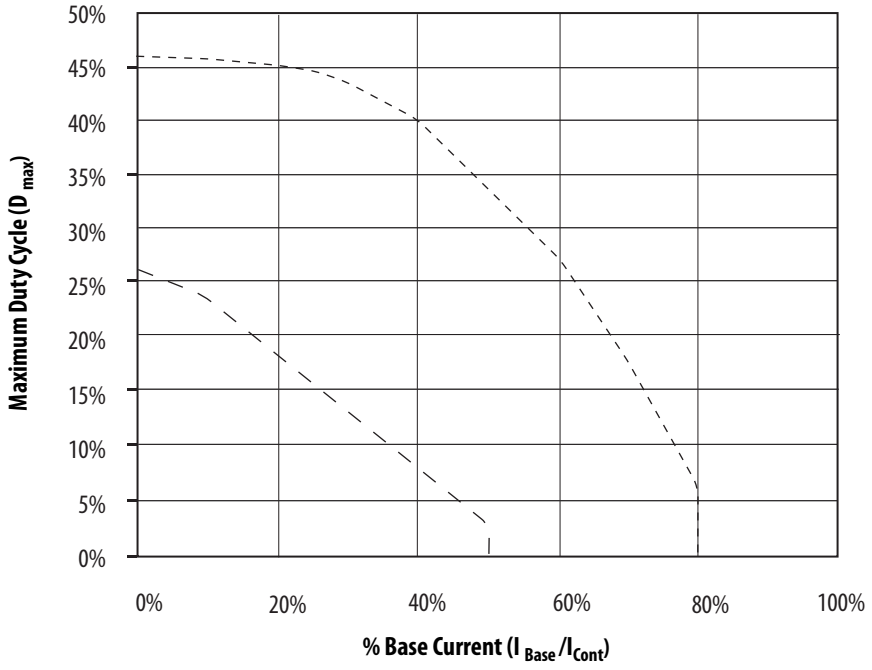
(1) All current values are specified as RMS.

Peak Enhanced Inverter Mode (T_{PK} < 2.0 s)



(1) Base current (I_{Base}) and peak current (I_{PK} are a percentage of the continuous drive current rating (I_{Cont}).

Peak Inverter Overload (T_{PK} < 2.0 s)



(1) Base current (I_{Base}) and peak current (I_{PK}) are a percentage of the continuous drive current rating (I_{Cont}).

Circuit Breaker/Fuse Specifications

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses. Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. Evaluation of the short-circuit available current is critical and must be kept below the short-circuit current rating of the circuit breaker.

Use class CC, J, L, or R fuses, with current rating as indicated in the table below. The following fuse examples and Allen-Bradley circuit breakers are recommended for use with 2094-*x*C*xx*-M*xx*-S IAM modules when the Line Interface Module (LIM) is not used.

IMPORTANT LIM Modules (catalog numbers 2094-AL*xx*S, 2094-BL*xx*S, and 2094-XL75S-C*x*) provide branch circuit protection to the IAM module. Follow all applicable NEC and local codes.

IAM Module Cat. No.	V AC Input Power			Control Input Power		DC Common Bus Fuse	
	Bussmann Fuse	Allen-Bradley Circuit Breaker		Bussmann Fuse (1)	Allen-Bradley (2) Circuit Breaker	Bussmann Fuse	Ferraz Shawmut Fuse
		Disconnect	Magnetic Contactor				
2094-AC05-MP5-S	KTK-R-20 (20 A)	1492-SP3D300	140M-F8E-C16	FNQ-R-10 (10 A)	1492-SP2D060	N/A	A50P20-1
2094-AC05-M01-S							
2094-AC09-M02-S	KTK-R-30 (30 A)	1492-SP3D400	140M-F8E-C20			FWH-35B	A50P35-4
2094-AC16-M03-S	LPJ-45SP (45 A)	N/A	140U-H6C3-C50		1492-SP2D200	FWH-60B	A50P60-4
2094-AC32-M05-S	LPJ-80SP (80 A)	N/A	140U-H6C3-C90			FWH-125B	A50P125-4
2094-BC01-MP5-S	KTK-R-20 (20 A)	1492-SP3D300	140M-F8E-C32	FNQ-R-10 (10 A) or FNQ-R-7.5 (7.5 A)	1492-SP2D060 or 1492-SP1D150	FWJ-20A14F	DCT20-2
2094-BC01-M01-S							
2094-BC02-M02-S	KTK-R-30 (30 A)	1492-SP3D400	140M-F8E-C45			FWJ-40A	A70QS40-4
2094-BC04-M03-S	LPJ-45SP (45 A)	N/A	140U-H6C3-C50			FWJ-70A	A70QS70-4
2094-BC07-M05-S	LPJ-80SP (80 A)		140U-H6C3-C90			FWJ-125A	A70QS125-4

(1) Use FNQ-R-7.5 fuse for higher single-cycle inrush current capability. This is recommended when the continuous control power current exceeds 3.0 A.

(2) Use 1492-SP1D150 circuit breaker for higher single-cycle inrush current capability. This is recommended when the continuous control power current exceeds 3.0 A.

Contactor Ratings

This table lists the recommended contactor ratings for integrated axis modules installed without a line interface module.

IAM Module (200V-class) Cat. No.	Contactor
2094-AC05-MP5-S	100-C23x10 (AC coil) 100-C23Zx10 (DC coil)
2094-AC05-M01-S	
2094-AC09-M02-S	100-C37x10 (AC coil) 100-C37Zx10 (DC coil)
2094-AC16-M03-S	100-C72x10 (AC coil) 100-C72Zx10 (DC coil)
2094-AC32-M05-S	100-C85x10 (AC coil) 100-C85Zx10 (DC coil)

IAM Module (400V-class) Cat. No.	Contactor
2094-BC01-MP5-S	100-C23x10 (AC coil) 100-C23Zx10 (DC coil)
2094-BC01-M01-S	
2094-BC02-M02-S	100-C37x10 (AC coil) 100-C37Zx10 (DC coil)
2094-BC04-M03-S	100-C60x10 (AC coil) 100-C60Zx10 (DC coil)
2094-BC07-M05-S	100-C72x10 (AC coil) 100-C72Zx10 (DC coil)

Input Transformer for Control Power

Attribute	Value	Cat. No. (1)
Input volt-amperes	750VA	1497B-A10-*xx-x*-N
	1000VA	1497B-A11-*xx-x*-N
	1500VA	1497B-A12-*xx-x*-N
Input voltage	460V AC	
Output voltage	120…240V AC	

(1) Variables (*xx-x*) determine the input voltage and wiring configuration.

Power Dissipation Specifications

Use this table to size an enclosure and calculate required ventilation for your Kinetix 6000 drive system.

Bulletin 2094 Drive Modules	Usage as % of Rated Power Output (watts)				
	20%	40%	60%	80%	100%
IAM (converter) module (1)					
2094-AC05-MP5-S	8	11	15	19	24
2094-AC05-M01-S	9	12	16	20	25
2094-AC09-M02-S	14	20	28	36	46
2094-AC16-M03-S	19	30	43	58	74
2094-AC32-M05-S	41	68	100	136	176
2094-BC01-MP5-S	18	21	25	29	34
2094-BC01-M01-S					33
2094-BC02-M02-S	36	44	54	64	75
2094-BC04-M03-S	50	67	87	110	135
2094-BC07-M05-S	71	101	137	179	226
IAM (inverter) module or AM module (2)					
2094-AC05-MP5-S or 2094-AMP5-S	28	32	37	41	46
2094-AC05-M01-S or 2094-AM01-S	31	38	46	54	62
2094-AC09-M02-S or 2094-AM02-S	34	45	57	70	84
2094-AC16-M03-S or 2094-AM03-S	48	68	91	116	144
2094-AC32-M05-S or 2094-AM05-S	104	156	212	274	342
2094-BC01-MP5-S or 2094-BMP5-S	46	54	61	69	77
2094-BC01-M01-S or 2094-BM01-S	57	73	90	108	126
2094-BC02-M02-S or 2094-BM02-S	53	72	93	116	142
2094-BC04-M03-S or 2094-BM03-S	94	130	169	211	255
2094-BC07-M05-S or 2094-BM05-S	121	183	252	326	407
Shunt module - 2094-BSP2	68	121	174	227	280
IPIM module - 2094-SEPM-B24-S	To calculate power dissipation for IPIM modules on your 2094 power rail, refer to the Kinetix 6000M Integrated Drive-Motor User Manual, publication 2094-UM003.				

(1) Internal shunt power is not included in the calculations and must be added based on utilization.

Power dissipation specifications are based on these calculations. This is an example:
2094-BC02-M02-S with 4.52 A_{DC} (=20%) converter DC current and 10.3 A_{rms} (=100%) inverter output current.
Converter loss (36 W) + Inverter loss (142 W) = 178 W total power dissipation.

Weight Specifications

Kinetix 6000 Drive Module	Cat. No.	Weight, approx kg (lb)
IAM (200V-class)	2094-AC05-MP5-S	2.23 (4.9)
	2094-AC05-M01-S	2.27 (5.0)
	2094-AC09-M02-S	2.31 (5.1)
	2094-AC16-M03-S	4.71 (10.4)
	2094-AC32-M05-S	7.43 (16.4)
AM (200V-class)	2094-AMP5-S	1.46 (3.2)
	2094-AM01-S	1.50 (3.3)
	2094-AM02-S	1.54 (3.4)
	2094-AM03-S	3.13 (6.9)
	2094-AM05-S	3.18 (7.0)
Power rails (Slim)	2094-PRS1	1.05 (2.3)
	2094-PRS2	1.59 (3.5)
	2094-PRS3	2.14 (4.7)
	2094-PRS4	2.67 (5.9)
	2094-PRS5	3.11 (6.8)
	2094-PRS6	3.55 (7.8)
	2094-PRS7	3.99 (8.8)
	2094-PRS8	4.43 (9.7)

Kinetix 6000 Drive Module	Cat. No.	Weight, approx kg (lb)
IAM (400V-class)	2094-BC01-MP5-S	4.98 (11.0)
	2094-BC01-M01-S	5.03 (11.1)
	2094-BC02-M02-S	5.08 (11.2)
	2094-BC04-M03-S	9.60 (21.1)
	2094-BC07-M05-S	10.1 (22.3)
AM (400V-class)	2094-BMP5-S	2.44 (5.4)
	2094-BM01-S	2.49 (5.5)
	2094-BM02-S	2.54 (5.6)
	2094-BM03-S	4.58 (10.1)
	2094-BM05-S	4.98 (11.0)
Shunt module	2094-BSP2	3.10 (6.8)
Slot-filler module	2094-PRF	0.45 (1.0)
IPIM (400V-class)	2094-SEPM-B24-S	3.5 (7.8)

Maximum Feedback Cable Lengths

Although motor feedback cables are available in standard lengths up to 90 m (295.3 ft), the drive/motor/feedback combination may limit the maximum feedback cable length. These tables assume the use of recommended cables as shown in the Kinetix Motion Accessories Technical Data, publication GMC-TD004.

Cable Lengths for Compatible Rotary Motors

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)	Resolver m (ft)
MPL-A15*xxx*… MPL-A2*xxx*-E/V	30 (98.4)			
MPL-A3*xxx*… MPL-A5*xxx*-S/M (1)	30 (98.4)			
MPL-B15*xxx*… MPL-B2*xxx*-E/V		90 (295.3)		
MPL-B3*xxx*… MPL-B5*xxx*-S/M		90 (295.3)		
MPL-A/B15*xxx*… MPL-A/B45*xxx*-H			30 (98.4)	
MPL-B*xxxx*-R				90 (295.3)
MPM-A*xxxxx*-S/M	30 (98.4)			
MPM-B*xxxxx*-S/M		90 (295.3)		

Cable Lengths for Compatible Rotary Motors (continued)

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)	Resolver m (ft)
MPM-A/B*xxxxx*-2				90 (295.3)
MPF-A*xxxx*-S/M (1)	30 (98.4)			
MPF-B*xxxx*-S/M		90 (295.3)		
MPS-A*xxxx*-S/M	30 (98.4)			
MPS-B*xxxx*-S/M		90 (295.3)		
RDB-B215*xx*-7/3	30 (98.4)			
RDB-B290*xx*-7/3 or RDB-B410*xx*-7/3	90 (295.3)			
TLY-A*xxxx*-H			30 (98.4)	

(1) MPL-A5*xxx* and MPF-A5*xxx* motor encoders are rated for 9V, the remaining Bulletin MPL and MPF (200V-class) motor encoders are rated for 5V.

Cable Lengths for Compatible Linear Actuators

Actuator Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)	Absolute High-resolution (5V) 17-bit Encoder m (ft)
MPMA-A*xxxxx* or MPAS-A*xxxxx*-V (ballscrew)	30 (98.4)			
MPMA-A*xxxxx* or MPAS-A*xxxxx*-A (direct drive)			30 (98.4)	
MPMA-B*xxxxx* or MPAS-B*xxxxx*-V (ballscrew)		90 (295.3)		
MPMA-B*xxxxx* or MPAS-B*xxxxx*-A (direct drive)			30 (98.4)	
MPAR-A*xxxxx*-V/M	30 (98.4)			
MPAR-B*xxxxx*-V/M		90 (295.3)		
TLAR-A*xxxxx*-B				30 (98.4)
MPAI-A*xxxxx*M3	30 (98.4)			
MPAI-B*xxxxx*M3		90 (295.3)		

Cable Lengths for Compatible Linear Motors

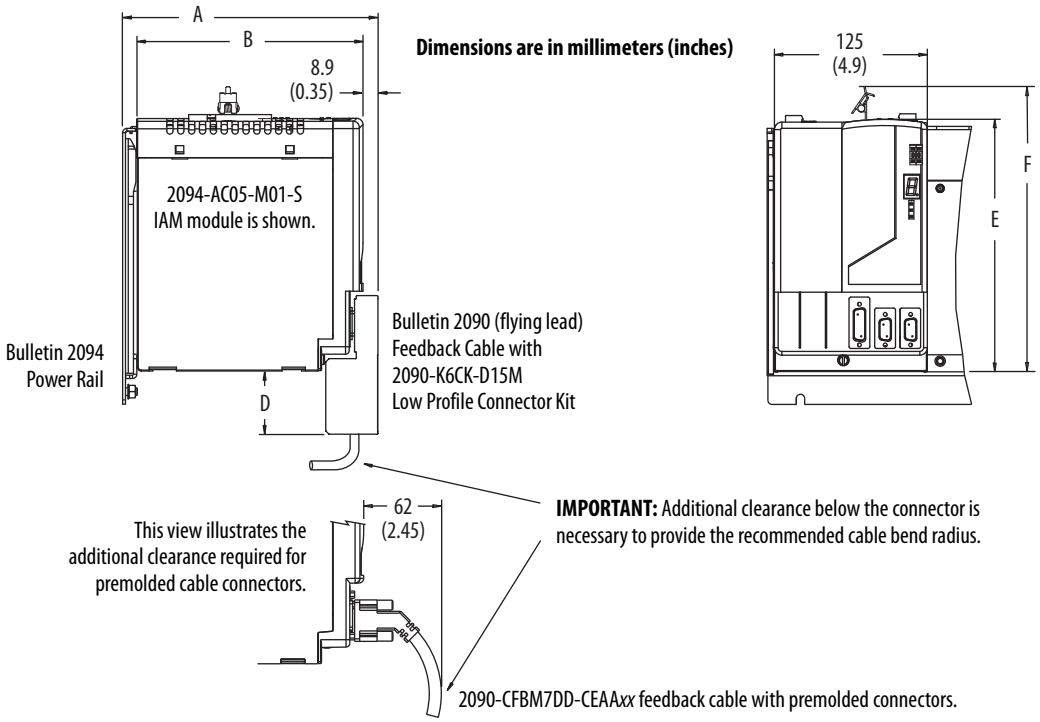
Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)
LDC-Series or LDL-Series™	30 (98.4)	30 (98.4)

Maximum Power Cable Length

Although motor power cables are available in standard lengths up to 90 m (295.3 ft) and the Kinetix 6000 power rail is available in sizes up to eight axes, to meet CE requirements and improve system performance the combined motor power length for all axes on the same DC bus must not exceed 160 m (525 ft) for 200V-class systems and 240 m (787 ft) for 400V-class systems.

Dimensions - Kinetix 6000 Multi-axis Servo Drives

2094-AC05-MP5-S, 2094-AC05-M01-S, and 2094-AC09-M02-S Dimensions (200V-class)
2094-BC01-MP5-S, 2094-BC01-M01-S, and 2094-BC02-M02-S Dimensions (400V-class)

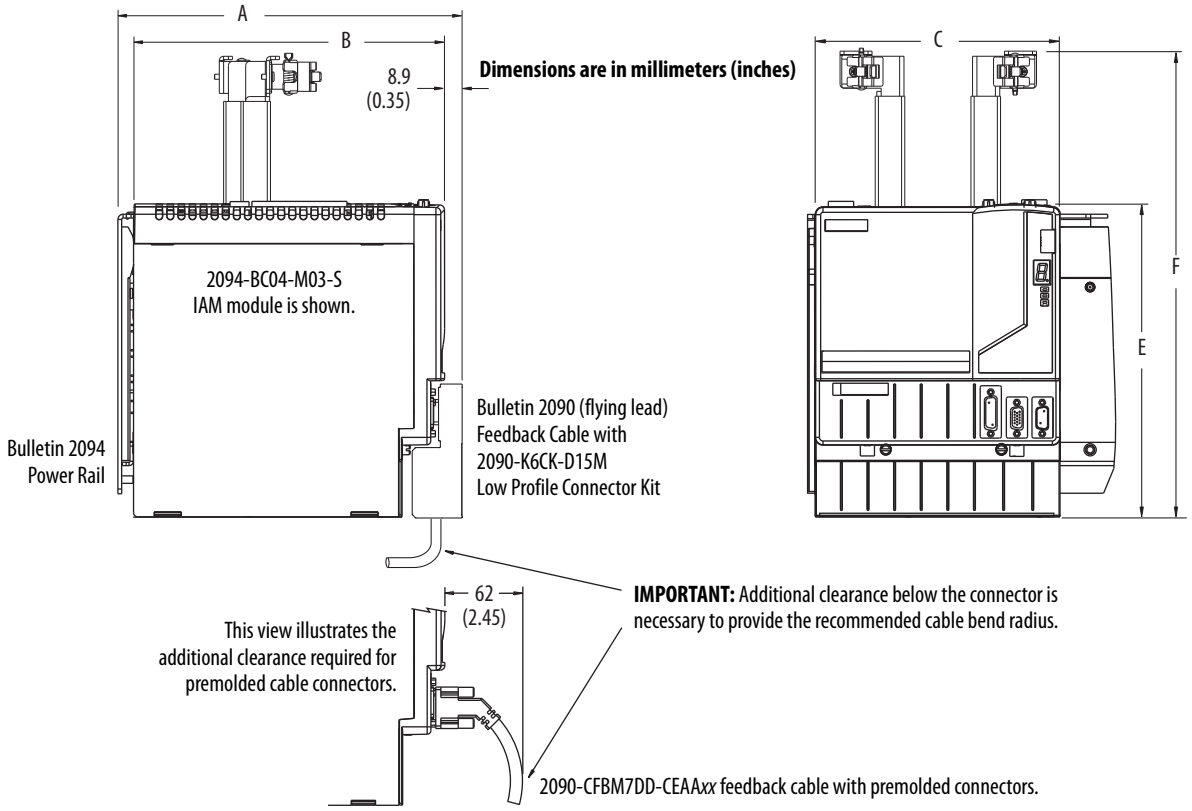


Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

IAM Module Dimensions (series A and B)

IAM Module Cat. No.	A mm (in.)	B mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)
2094-AC05-MP5-S	198 (7.8)	176 (7.0)	51 (2.0)	206 (8.2)	237 (9.3)
2094-AC05-M01-S					
2094-AC09-M02-S					
2094-BC01-MP5-S	272 (10.7)	249 (9.8)	0 (0)	256 (10.1)	287 (11.3)
2094-BC01-M01-S					
2094-BC02-M02-S					

2094-AC16-M03-S and 2094-AC32-M05-S Dimensions (200V-class)
2094-BC04-M03-S and 2094-BC07-M05-S Dimensions (400V-class)



Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

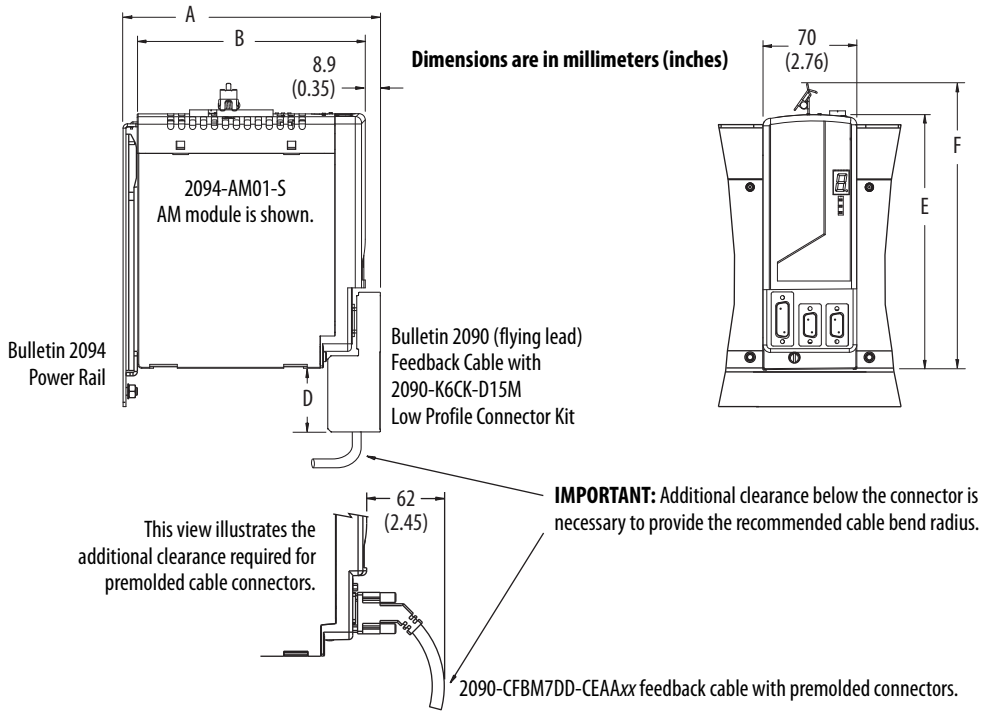
IAM Module Dimensions (series A)

IAM Module Cat. No.	A mm (in.)	B mm (in.)	C mm (in.)	E mm (in.)	F mm (in.)
2094-AC16-M03-S	198 (7.8)	176 (7.0)	125 (4.9)	302 (11.9)	420 (16.5)
2094-AC32-M05-S			196 (7.7)		
2094-BC04-M03-S	272 (10.7)	249 (9.8)	196 (7.7)	256 (10.1)	375 (14.7)
2094-BC07-M05-S				318 (12.5)	436 (17.2)

IAM Module Dimensions (series B)

IAM Module Cat. No.	A mm (in.)	B mm (in.)	C mm (in.)	E mm (in.)	F mm (in.)
2094-BC04-M03-S	272 (10.7)	249 (9.8)	196 (7.7)	256 (10.1)	375 (14.7)
2094-BC07-M05-S					

2094-AMP5-S, 2094-AM01-S, and 2094-AM02-S Dimensions (200V-class)
2094-BMP5-S, 2094-BM01-S, and 2094-BM02-S Dimensions (400V-class)

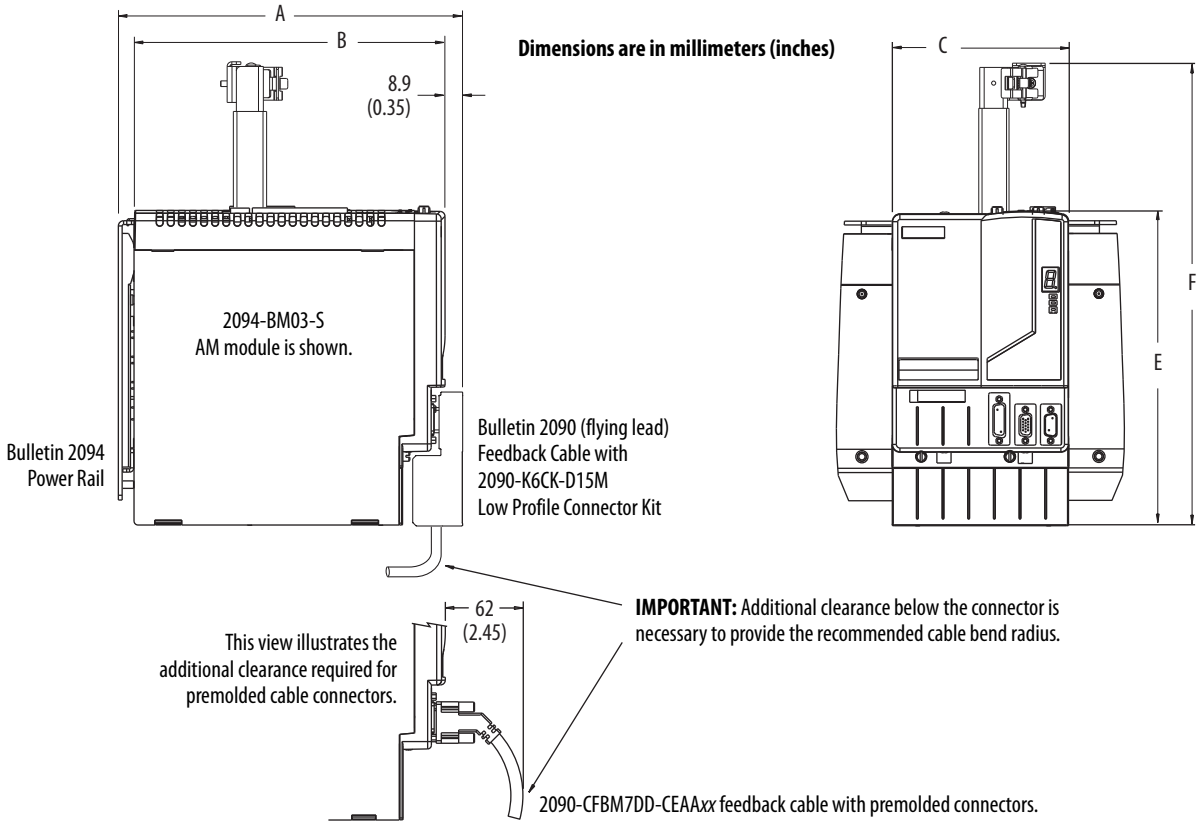


Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

AM Module Dimensions (series A and B)

AM Module Cat. No.	A mm (in.)	B mm (in.)	D mm (in.)	E mm (in.)	F mm (in.)
2094-AMP5-S	198 (7.8)	176 (7.0)	51 (2.0)	206 (8.2)	237 (9.3)
2094-AM01-S					
2094-AM02-S					
2094-BMP5-S	272 (10.7)	249 (9.8)	0 (0)	256 (10.1)	287 (11.3)
2094-BM01-S					
2094-BM02-S					

2094-AM03-S and 2094-AM05-S Dimensions (200V-class)
2094-BM03-S and 2094-BM05-S Dimensions (400V-class)



Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

AM Module Dimensions (series A)

AM Module Cat. No.	A mm (in.)	B mm (in.)	C mm (in.)	E mm (in.)	F mm (in.)
2094-AM03-S	198 (7.8)	176 (7.0)	70 (2.8)	302 (11.9)	420 (16.5)
2094-AM05-S					
2094-BM03-S	272 (10.7)	249 (9.8)	141 (5.5)	256 (10.1)	375 (14.7)
2094-BM05-S				318 (12.5)	436 (17.2)

AM Module Dimensions (series B)

AM Module Cat. No.	A mm (in.)	B mm (in.)	C mm (in.)	E mm (in.)	F mm (in.)
2094-BM03-S	272 (10.7)	249 (9.8)	141 (5.5)	256 (10.1)	375 (14.7)
2094-BM05-S					

Environmental Specifications - Kinetix 6000 Servo Drives

Attribute	Operational Range	Storage Range (nonoperating)
Temperature, ambient	0…50 °C (32…122 °F)	-40…70 °C (-40…158 °F)
Relative humidity	5…95% noncondensing	5…95% noncondensing
Altitude	1000 m (3281 ft) 3000 m (9843 ft) with derating	3000 m (9843 ft) during transport
Vibration	5…55 Hz @ 0.35 mm (0.014 in.) double amplitude, continuous displacement; 55…500 Hz @ 2.0 g peak constant acceleration (10 sweeps in each of 3 mutually perpendicular directions)	
Shock	15 g, 11 ms half-sine pulse (3 pulses in each direction of 3 mutually perpendicular directions)	

Certifications - Kinetix 6000 Servo Drives

Agency Certification (1)	Standards
c-UL-us (2)	UL Listed to U.S. and Canadian safety standards (UL 508C File E59272).
	Solid-state motor overload protection provides dynamic fold-back of motor current when 110% of the motor rating is reached with a peak current limit based on the peak rating of the motor as investigated by UL to comply with UL 508C (UL File E59272, volume 1, section 22).
CE	European Union 2004/108/EC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC requirements and specific test methods.
	European Union 2006/95/EC Low Voltage Directive compliant with: • EN 61800-5-1:2007 - Adjustable speed electrical power drive systems. • EN 50178:1997 - Electronic Equipment for use in Power Installations.
Functional Safety	• EN 60204-1:2006 - Safety of Machinery - Electrical Equipment of Machines. • IEC 61508: Part 1-7:2000 - Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems. • EN ISO 13849-1:2008 - Safety of machinery. Safety related parts of control systems. Part 1: General principles for design.
C-Tick	Australian Radio Communications Act, compliant with: • Radio Communications Act: 1992 • Radio Communications (Electromagnetic Compatibility) Standard: 1998 • Radio Communications (Compliance Labelling - Incidental Emissions) Notice: 1998 • AS/NZS CISPR 11: 2003 (Group 2, Class A)
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3 • Registration number: KCC-REM-RAA-2094

(1) When product is marked, refer to http://www.ab.com for Declarations of Conformity Certificates.
(2) Underwriters Laboratories Inc. has not evaluated the safe-off option in these products.

Kinetix 300 and Kinetix 350 EtherNet/IP Servo Drives

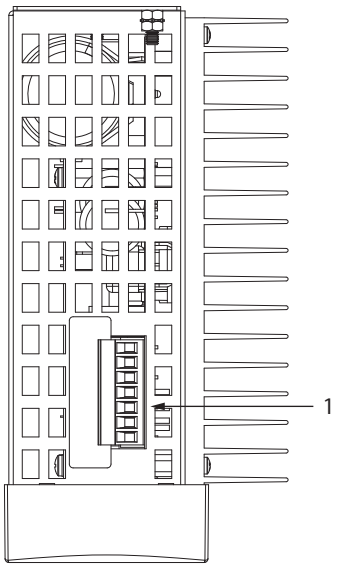
Kinetix 300 Servo Drive

The Kinetix 300 EtherNet/IP indexing drive provides a cost-effective single-axis solution for low axis-count motion control applications. Using one standard Ethernet/IP network for an entire machine - including Motion, Control, I/O, and HMI simplifies wiring, reduces panel layout costs, and allows easy integration into manufacturing and enterprise systems. In addition, safe torque-off functionality helps protect personnel while increasing machine productivity.

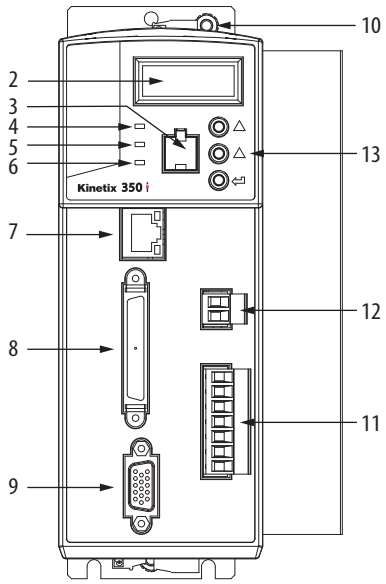
Kinetix 350 Servo Drive

The Kinetix 350 single-axis EtherNet/IP servo drive was developed to provide scalability for your motion control system by simplifying integration of the entire control solution on one network. The Kinetix 350 servo drive is designed to connect and operate with the ControlLogix® controllers supporting Integrated Motion on the EtherNet/IP network. Combined as a system, they can provide you a cost-effective motion solution that delivers the high performance and scalability you need to compete in today's industry. With its compact design, the Kinetix 350 requires less panel space and can be connected easily. In addition, you can reduce installation and commissioning time by re-using code across integrated products throughout your entire machine portfolio.

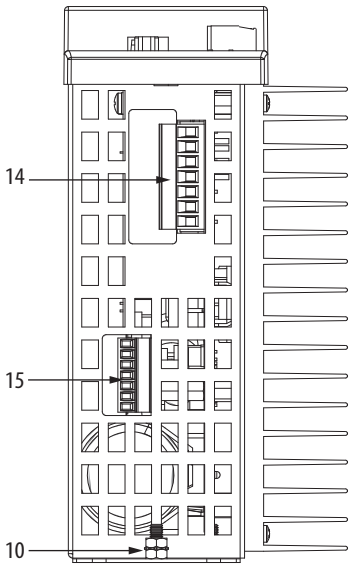
Kinetix 300 and Kinetix 350 Drive Features and Indicators



Kinetix 300/350 Drive, Top View
(2097-V33PR5-*xx* drive is shown)



Kinetix 300/350 Drive, Front View
(2097-V33PR5-LM drive is shown)



Kinetix 300/350 Drive, Bottom View
(2097-V33PR5-*xx* drive is shown)

Item	Description
1	Mains (IPD) connector
2	Status and diagnostic display
3	Memory module socket
4	Network status indictor (2)
5	Module status indictor (2)
6	Axis status indictor (2)
7	Ethernet communication port (Port 1)
8	I/O (IOD) connector

Item	Description
9	Motor feedback (MF) connector (1)
10	Ground lug
11	Shunt resistor and DC bus (BC) connector
12	Back-up power (BP) connector
13	Display control push buttons (3)
14	Motor power (MP) connector
15	Safe torque-off (STO) connector

(1) The MF (15-pin) connector requires the 2090-K2CK-D15M low-profile connector kit.
(2) Status indicators apply to only Kinetix 350 servo drives.

Technical Specifications - Kinetix 300 and Kinetix 350 Servo Drives

The 2097-V31PR*x-xx* drives with 120V input are capable of driving 240V motors at full speed.

Kinetix 300/350 Drive (single-phase) Power Specifications

Attribute	2097-V31PR0-*xx*	2097-V31PR2-*xx*	2097-V32PR0-*xx*	2097-V32PR2-*xx*	2097-V32PR4-*xx*
AC input voltage	70…132V rms single-phase (120V nom) voltage-doubler mode 80…264V rms single-phase (120/240V nom)		80…264V rms single-phase (240V nom)		
AC input frequency	48…62 Hz				
Main AC input current (1)					
Nom (rms) 120V input (voltage doubler)	9.70 A	15.0 A			
Max inrush (0-pk) 120V input	1.15 A	1.15 A			
Nom (rms) 120/240V input	5.0 A	8.6 A	5.0 A	8.6 A	15.0 A
Max inrush (0-pk) 240V input	1.1 A	1.1 A	136 A	2.3 A	2.3 A
Integrated AC line filter	No	No	Yes	Yes	Yes
Control power back-up input voltage	20…26V DC				
Control power back-up input current					
Nom	500 mA				
Max inrush (0-pk)	30 A				
Continuous output current (rms)	2.0 A	4.0 A	2.0 A	4.0 A	8.0 A
Continuous output current (0-pk)	2.8 A	5.7 A	2.8 A	5.7 A	11.3 A
Peak output current (rms) (2)	6.0 A	12.0 A	6.0 A	12.0 A	24.0 A
Peak output current (0-pk)	8.5 A	17.0 A	8.5 A	17.0 A	33.9 A
Continuous power output (3) @ 240V nom or 120V (voltage-doubler) mode	0.40 kW (4)	0.80 kW (4)	0.40 kW	0.80 kW	1.70 kW
Shunt on	390V DC				
Shunt off	375V DC				
Overvoltage	430V DC				
Short circuit current rating	100,000 A (rms) symmetrical				

(1) Kinetix 300/350 drive modules are limited to 1 AC mains power cycling per every 2 minutes.

(2) Peak RMS current allowed for up to 2 seconds with a 50% duty cycle.

(3) Nominal continuous power output (kW) applies to 240V AC drives. Value is approximately one-half of this kW rating when using 120V AC.

(4) The 120V voltage-doubler mode applies to only the 2097-V31PR*x-xx* drives.

Kinetix 300/350 Drive (single-phase and three-phase) Power Specifications

Attribute	2097-V33PR1-*xx*	2097-V33PR3-*xx*	2097-V33PR5-*xx*	2097-V33PR6-*xx*
AC input voltage	80…132V rms single-phase (120V nom) 80…264V rms single-phase (240V nom) 80…264V rms three-phase (240V nom)			
AC input frequency	48…62 Hz			
Main AC input current (1)				
Nom (rms) 120/240V input, single-phase	5.0 A	8.6 A	15.0 A	24.0 A
Max inrush (0-pk) 120/240V input	68.0 A	1.15 A	1.15 A	5.65 A
Nom (rms) 240V input, three-phase	3.0 A	5.0A	8.7A	13.9 A
Max inrush (0-pk) 240V input	136 A	2.3 A	2.3 A	11.3 A
Integrated AC line filter	No	No	No	No
Control power back-up input voltage	20…26V DC			
Control power back-up input current				
Nom	500 mA			
Max inrush (0-pk)	30 A			
Continuous output current (rms)	2.0 A	4.0 A	8.0 A	12.0 A
Continuous output current (0-pk)	2.8 A	5.7 A	11.3 A	17.0 A
Peak output current (rms) (2)	6.0 A	12.0 A	24.0 A	36.0 A
Peak output current (0-pk)	8.5 A	17.0 A	33.9 A	50.9 A
Continuous power output (3) @ 240V nom	0.50 kW	1.00 kW	2.00 kW	3.00 kW
Shunt on	390V DC			
Shunt off	375V DC			
Overvoltage	430V DC			
Short circuit current rating	100,000 A (rms) symmetrical			

(1) Kinetix 300/350 drive modules are limited to 1 AC mains power cycling per every 2 minutes.

(2) Peak RMS current allowed for up to 2 seconds with a 50% duty cycle.

(3) Nominal continuous power output (kW) applies to 240V AC drives. Value is approximately one-half of this kW rating when using 120V AC.

Kinetix 300/350 Drive (three-phase) Power Specifications

Attribute	2097-V34PR3-*xx*	2097-V34PR5-*xx*	2097-V34PR6-*xx*
AC input voltage	320…528V rms three-phase (480V nom)		
AC input frequency	48…62 Hz		
Main AC input current (1) Nom (rms) Max inrush (0-pk)	 2.7 A 4.5 A	 5.5 A 4.5 A	 7.9 A 22.6 A
Integrated AC line filter	No	No	No
Control power back-up input voltage	20…26V DC		
Control power back-up input current Nom Max inrush (0-pk)	 500 mA 30 A		
Continuous output current (rms)	2.0 A	4.0 A	6.0 A
Continuous output current (0-pk)	2.8 A	5.7 A	8.5 A
Peak output current (rms) (2)	6.0 A	12.0 A	18.0 A
Peak output current (0-pk)	8.5 A	17.0 A	25.5 A
Continuous power output @ 480V nom	1.00 kW	2.00 kW	3.00 kW
Shunt on	780V DC		
Shunt off	750V DC		
Overvoltage	850V DC		
Short circuit current rating	100,000 A (rms) symmetrical		

(1) Kinetix 300/350 drive modules are limited to 1 AC mains power cycling per every 2 minutes.
(2) Peak RMS current allowed for up to 2 seconds with a 50% duty cycle.

Circuit Breaker/Fuse Specifications

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses.

Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. Evaluation of the short-circuit available current is critical and must be kept below the short-circuit current rating of the circuit breaker.

Use class CC or T fast-acting current-limiting type fuses, 200,000 AIC, preferred. Use Bussman KTK-R, JJN, JJS, or equivalent. Thermal-magnetic type breakers preferred. The following fuse examples and Allen-Bradley circuit breakers are recommended for use with Kinetix 300 and Kinetix 350 servo drives.

Fuse and Circuit Breaker Specifications

Drive Cat. No.	Drive Voltage	Phase	Main VAC		
			Bussmann Fuse	Allen-Bradley Circuit Breaker (1)	
				Disconnect (2)	Magnetic Contactor (3)
2097-V31PR0-*xx*	120V	Single-phase (voltage doubler)	KTK-R-20 (20 A)	1492-SP1D200	140M-F8E-C20
	120/240V	Single-phase	KTK-R-10 (10 A)	1492-SP1D100	140M-F8E-C10
2097-V31PR2-*xx*	120V	Single-phase (voltage doubler)	KTK-R-30 (30 A)	1492-SP1D300	140M-F8E-C32
	120/240V	Single-phase	KTK-R-20 (20 A)	1492-SP1D200	140M-F8E-C20
2097-V32PR0-*xx*	240V	Single-phase	KTK-R-15 (15 A)	1492-SP3D150	140M-F8E-C16
2097-V32PR2-*xx*			KTK-R-20 (20 A)	1492-SP3D200	140M-F8E-C20
2097-V32PR4-*xx*			KTK-R-30 (30 A)	1492-SP3D320	140M-F8E-C32
2097-V33PR1-*xx*	120/240V	Single-phase	KTK-R-20 (20 A)	1492-SP1D200	140M-F8E-C20
	240V	Three-phase	KTK-R-15 (15 A)	1492-SP3D150	140M-F8E-C16
2097-V33PR3-*xx*	120/240V	Single-phase	KTK-R-20 (20 A)	1492-SP1D200	140M-F8E-C20
	240V	Three-phase	KTK-R-15 (15 A)	1492-SP3D150	140M-F8E-C16
2097-V33PR5-*xx*	120/240V	Single-phase	KTK-R-30 (30 A)	1492-SP1D300	140M-F8E-C32
	240V	Three-phase	KTK-R-20 (20 A)	1492-SP3D200	140M-F8E-C20
2097-V33PR6-*xx*	120/240V	Single-phase	LPJ-40SP	N/A	140M-F8E-C32
	240V	Three-phase	KTK-R-30 (30 A)	1492-SP3D300	
2097-V34PR3-*xx*	480V	Three-phase	KTK-R-10 (10 A)	1492-SP3D100	140M-F8E-C10
2097-V34PR5-*xx*			KTK-R-10 (10 A)	1492-SP3D100	140M-F8E-C10
2097-V34PR6-*xx*			KTK-R-20 (20 A)	1492-SP3D200	140M-F8E-C20

(1) When using Bulletin 1492 circuit protection devices, the maximum short circuit current available from the source is limited to 5000 A.
(2) Use fully-rated short-circuit protection circuit breaker for device branch circuit protection only when there is an upstream fully-rated breaker.
(3) Fully-rated breaker for overload current and short circuit rating.

Contactor Ratings

Kinetix 300/350 Drives (120/240V)

Cat. No.	Drive Voltage	AC Coil Contactor	DC Coil Contactor
2097-V31PR0-*xx*	120V	100-C23x10	100-C23Zx10
	240V	100-C12x10	100-C12Zx10
2097-V31PR2-*xx*	120V	100-C30x10	100-C30Zx10
	240V	100-C23x10	100-C23Zx10

Kinetix 300/350 Drives (240V)

Cat. No.	Drive Voltage	AC Coil Contactor	DC Coil Contactor
2097-V32PR0-*xx*	240V	100-C23x10	100-C23Zx10
2097-V32PR2-*xx*	240V	100-C23x10	100-C23Zx10
2097-V32PR4-*xx*	240V	100-C30x10	100-C30Zx10
2097-V33PR1-*xx*	120V	100-C23x10	100-C23Zx10
	240V	100-C16x10	100-C16Zx10
2097-V33PR3-*xx*	120V	100-C23x10	100-C23Zx10
	240V	100-C16x10	100-C16Zx10
2097-V33PR5-*xx*	120V	100-C30x10	100-C30Zx10
	240V	100-C23x10	100-C23Zx10
2097-V33PR6-*xx*	120V	N/A	N/A
	240V	100-C30x10	100-C30Zx10

Kinetix 300/350 Drives (480V)

Cat. No.	Drive Voltage	AC Coil Contactor	DC Coil Contactor
2097-V34PR3-*xx*	480V	100-C12x10	100-C12Zx10
2097-V34PR5-*xx*		100-C12x10	100-C12Zx10
2097-V34PR6-*xx*		100-C23x10	100-C23Zx10

Transformer Specifications for Control Input Power

Attribute	Value (400V-class system)
Input volt-amperes	750VA
Input voltage	460V AC
Output voltage	120…240V AC

Power Dissipation Specifications

Use this table to size an enclosure and calculate required ventilation for your Kinetix 300/350 drive system.

Drive Cat. No.	Loss, max W
2097-V31PR0-*xx*	28
2097-V31PR2-*xx*	39
2097-V32PR0-*xx*	28
2097-V32PR2-*xx*	39
2097-V32PR4-*xx*	67
2097-V33PR1-*xx*	28

Drive Cat. No.	Loss, max W
2097-V33PR3-*xx*	39
2097-V33PR5-*xx*	67
2097-V33PR6-*xx*	117
2097-V34PR3-*xx*	39
2097-V34PR5-*xx*	58
2097-V34PR6-*xx*	99

Weight Specifications

Drive Cat. No.	Weight, approx kg (lb)
2097-V31PR0-*xx*	1.3 (2.9)
2097-V31PR2-*xx*	1.5 (3.3)
2097-V32PR0-*xx*	1.4 (3.1)
2097-V32PR2-*xx*	1.7 (3.7)
2097-V32PR4-*xx*	2.2 (4.9)
2097-V33PR1-*xx*	1.3 (2.9)

Drive Cat. No.	Weight, approx kg (lb)
2097-V33PR3-*xx*	1.5 (3.3)
2097-V33PR5-*xx*	2.0 (4.4)
2097-V33PR6-*xx*	1.9 (4.2)
2097-V34PR3-*xx*	1.5 (3.3)
2097-V34PR5-*xx*	2.0 (4.4)
2097-V34PR6-*xx*	1.8 (4.0)

Maximum Feedback Cable Lengths

Although motor power and feedback cables are available in standard lengths up to 90 m (295.3 ft), Kinetix 300/350 drive maximum feedback cable length is 20 m (65.6 ft). These tables assume the use of recommended cables as shown in the Kinetix Motion Accessories Technical Data, publication GMC-TD004.

Cable Lengths for Compatible Rotary Motors

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)	Absolute High-resolution (5V) 17-bit Encoder m (ft)
MPL-A3*xxx*… MPL-A5*xxx*-S/M (1)	20 (65.6)			
MPL-A15*xxx*… MPL-A2*xxx*-E/V	20 (65.6)			
MPL-B3*xxx*… MPL-B9*xxx*-S/M		20 (65.6)		
MPL-B15*xxx*… MPL-B2*xxx*-E/V		20 (65.6)		
MPL-A/B15*xxx*… MPL-A/B45*xxx*-H			20 (65.6)	
MPM-A*xxxxx*-S/M	20 (65.6)			
MPM-B*xxxxx*-S/M		20 (65.6)		
MPF-A*xxxx*-S/M (1)	20 (65.6)			

Cable Lengths for Compatible Rotary Motors (continued)

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)	Absolute High-resolution (5V) 17-bit Encoder m (ft)
MPF-B*xxxx*-S/M		20 (65.6)		
MPS-A*xxxx*-S/M	20 (65.6)			
MPS-B*xxxx*-S/M		20 (65.6)		
TLY-A*xxxx*-B				20 (65.6)
TLY-A*xxxx*-H			20 (65.6)	

(1) MPL-A5*xxx* and MPF-A5*xxx* motor encoders are rated for 9V, the remaining Bulletin MPL and MPF (200V-class) motor encoders are rated for 5V.

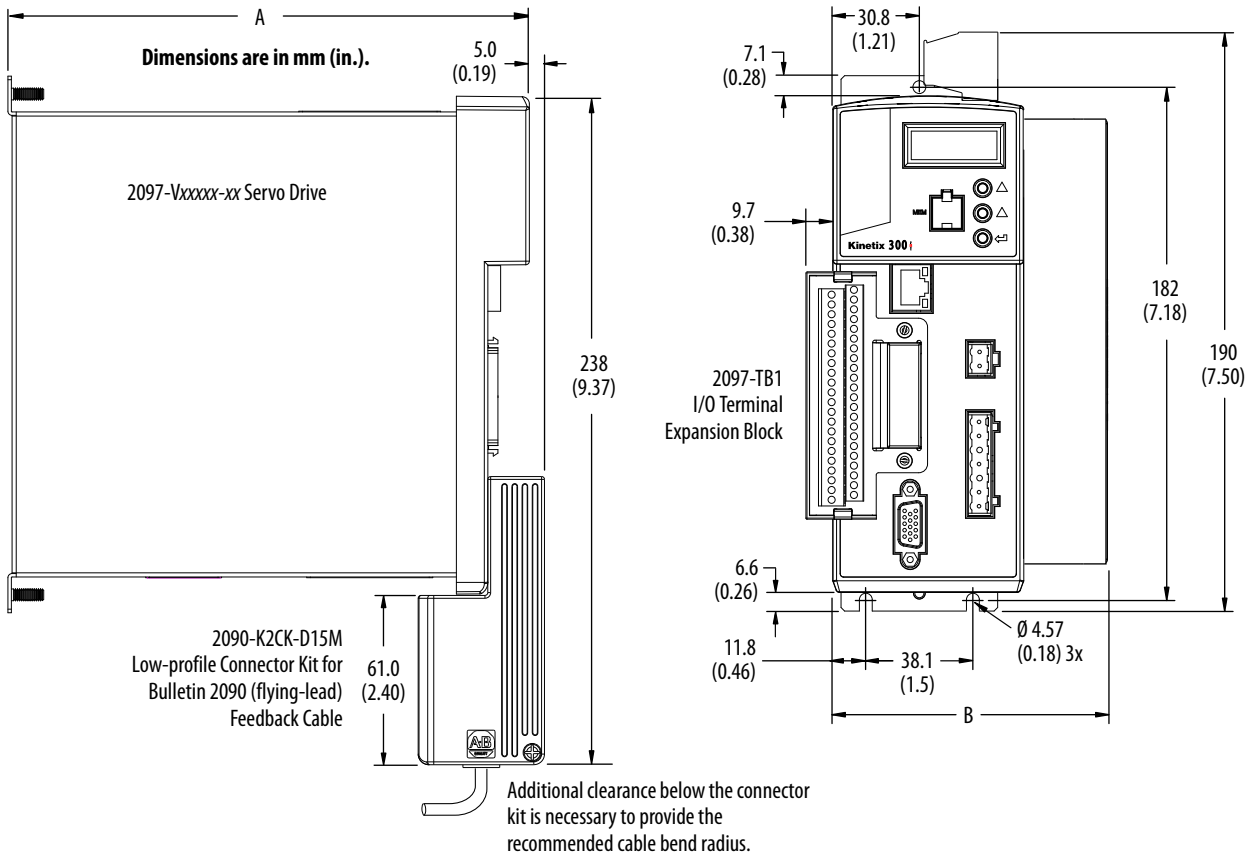
Cable Lengths for Compatible Linear Actuators

Actuator Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)	Absolute High-resolution (5V) 17-bit Encoder m (ft)
MPMA-A*xxxxx* or MPAS-A*xxxxx*-V (ballscrew)	20 (65.6)			
MPMA-A*xxxxx* or MPAS-A*xxxxx*-A (direct drive)			20 (65.6)	
MPMA-B*xxxxx* or MPAS-B*xxxxx*-V (ballscrew)		20 (65.6)		
MPMA-B*xxxxx* or MPAS-B*xxxxx*-A (direct drive)			20 (65.6)	
MPAR-A*xxxxx*-V/M	20 (65.6)			
MPAR-B*xxxxx*-V/M		20 (65.6)		
TLAR-A*xxxxx*-B			20 (65.6)	20 (65.6)
MPAI-A*xxxxx*M3	20 (65.6)			
MPAI-B*xxxxx*M3		20 (65.6)		

Cable Lengths for Compatible Linear Motors

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)
LDC-Series or LDL-Series	20 (65.6)	20 (65.6)

Dimensions - Kinetix 300 and Kinetix 350 Servo Drives



Kinetix 300/350 Drive Dimensions

Cat. No.	A mm (in.)	B mm (in.)
2097-V31PR0-*xx*	185 (7.29)	68.0 (2.68)
2097-V31PR2-*xx*	185 (7.29)	69.0 (2.70)
2097-V32PR0-*xx*	230 (9.04)	68.0 (2.68)
2097-V32PR2-*xx*	230 (9.04)	69.0 (2.70)
2097-V32PR4-*xx*	230 (9.04)	87.0 (3.42)
2097-V33PR1-*xx*	185 (7.29)	68.0 (2.68)

Cat. No.	A mm (in.)	B mm (in.)
2097-V33PR3-*xx*	185 (7.29)	69.0 (2.70)
2097-V33PR5-*xx*	185 (7.29)	94.0 (3.72)
2097-V33PR6-*xx*	230 (9.04)	68.0 (2.68)
2097-V34PR3-*xx*	185 (7.29)	69.0 (2.70)
2097-V34PR5-*xx*	185 (7.29)	94.0 (3.72)
2097-V34PR6-*xx*	230 (9.04)	68.0 (2.68)

Environmental Specifications - Kinetix 300 and Kinetix 350 Servo Drives

Attribute	Operational Range	Storage Range (nonoperating)
Temperature, ambient	0…40 °C (32…104 °F)	-10…70 °C (14…158 °F)
Relative humidity	5…95% noncondensing	5…95% noncondensing
Altitude	Derate by 1% per 300 m (1000 ft) above 1500 m (5000 ft)	3000 m (9842 ft) during transport
Vibration	5…2000 Hz @ 2.5 g peak, 0.015 mm (0.0006 in.) displacement, max	
Shock	15 g, 11 ms half-sine pulse (3 pulses in each direction of 3 mutually perpendicular directions)	

Certifications - Kinetix 300 and Kinetix 350 Servo Drives

Certification [1] (when product is marked)	Standards
c-UL-us [2]	UL Listed to U.S. and Canadian safety standards (UL 508 C File E59272).
	Solid-state motor overload protection provides dynamic fold-back of motor current when 110% of the motor rating is reached with a peak current limit based on the peak rating of the motor as investigated by UL to comply with UL 508C (UL File E59272, volume 1, section 22).
CE	European Union 2004/108/EC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC Product Standard including specific test methods.
	European Union 2006/95/EC Low Voltage Directive compliant with: • EN 61800-5-1:2007 - Adjustable speed electrical power drive systems. • EN 50178:1997 - Electronic Equipment for use in Power Installations.
Functional Safety	• EN 61800-5-2:2007 - Adjustable speed electrical power drive systems • EN 62061:2005 - Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems • EN ISO 13849-1:2008 - Safety of machinery - Safety-related parts of control systems • IEC 61508:Part 1-7:2000 - Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems
C-Tick	Australian Radio Communications Act, compliant with: • Radio Communications Act: 1992 • Radio Communications (Electromagnetic Compatibility) Standard: 1998 • Radio Communications (Compliance Labelling - Incidental Emissions) Notice: 1998 • AS/NZS CISPR 11: 2003 (Group 1, Class A)
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3 • Registration number: KCC-REM-RAA-2097

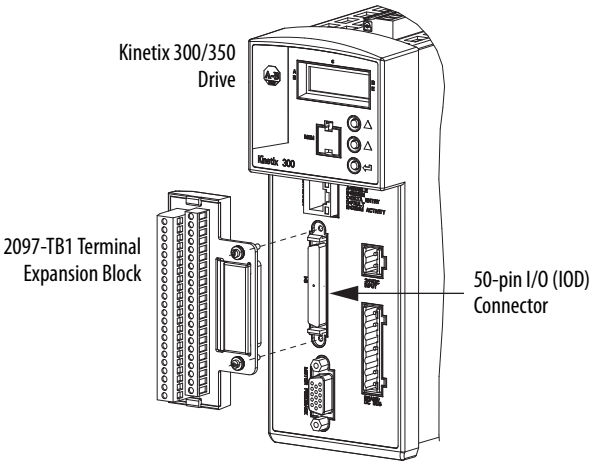
(1) Refer to http://www.ab.com for Declarations of Conformity Certificates.
(2) Underwriters Laboratories Inc. has not evaluated the safe torque-off option in these products.

Accessories - Kinetix 300 and Kinetix 350 Servo Drives

Kinetix 300/350 drive accessories include the I/O terminal block, memory module programmer, memory modules, AC line filters, and shunt resistors.

I/O Terminal Expansion Block

The 2097-TB1 I/O terminal expansion block is a drive-mounted breakout board for making flying-lead cable connections to the 50-pin IOD connector.



2097-TB1 I/O Terminal Block Specifications

Attribute	Value
Wire size	1.5…0.2 mm^2 (16…24 AWG)
Change in depth of drive [1]	11 mm (0.42 in.)
Change in width of drive [1]	10 mm (0.38 in.)

(1) Add this value to the dimensions of your Kinetix 300 drive.

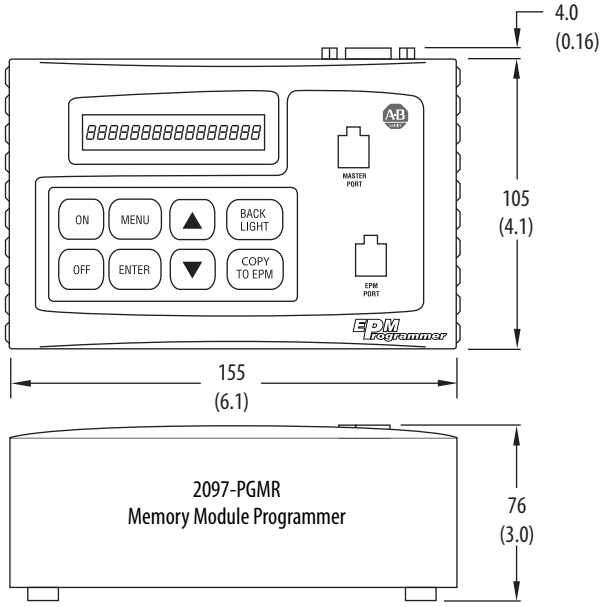
Memory Module Programmer

The 2097-PGMR memory module programmer is a hand-held device for duplicating your Kinetix 300/350 drive configuration to reduce down-time and troubleshooting.

2097-PGMR Memory Module Programmer Specifications

Attribute		Value
DC supply	Internal batteries	+ 6V DC, min 150 mA supply
		4 mono-cells (type D), 1.5V DC each
	External power supply unit	+ 6V DC, 300 mA, stabilized
Display	Type	LCD
	Display format	Text
	Lines x characters	1 x 16
	Contrast setting	Via menu
Memory	Data memory	Up to 120 parameter files for inverter drive controllers
Serial interface	DB9 connector	RS-232
Weight	2097-PGMR	1.3 kg (2.87 lb), with batteries

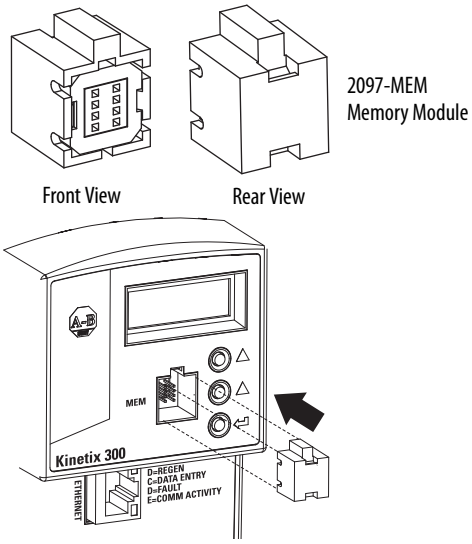
Dimensions are in mm (in.)



Memory Module 12-packs

The 2097-MEM memory modules use EEPROM technology in a plastic casing for protection and ruggedness to safe-guard your Kinetix 300/350 drive configuration.

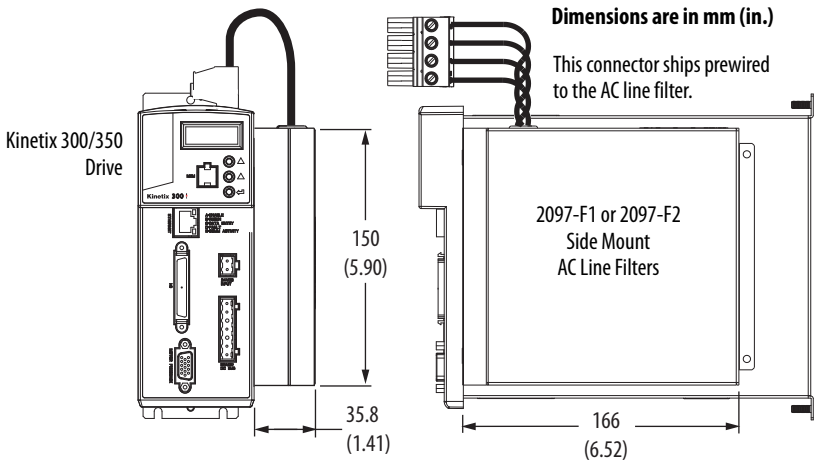
Use the 2097-MEM memory modules to back up your drive configuration for easy Automatic Device Replacement (ADR).



AC Line Filters

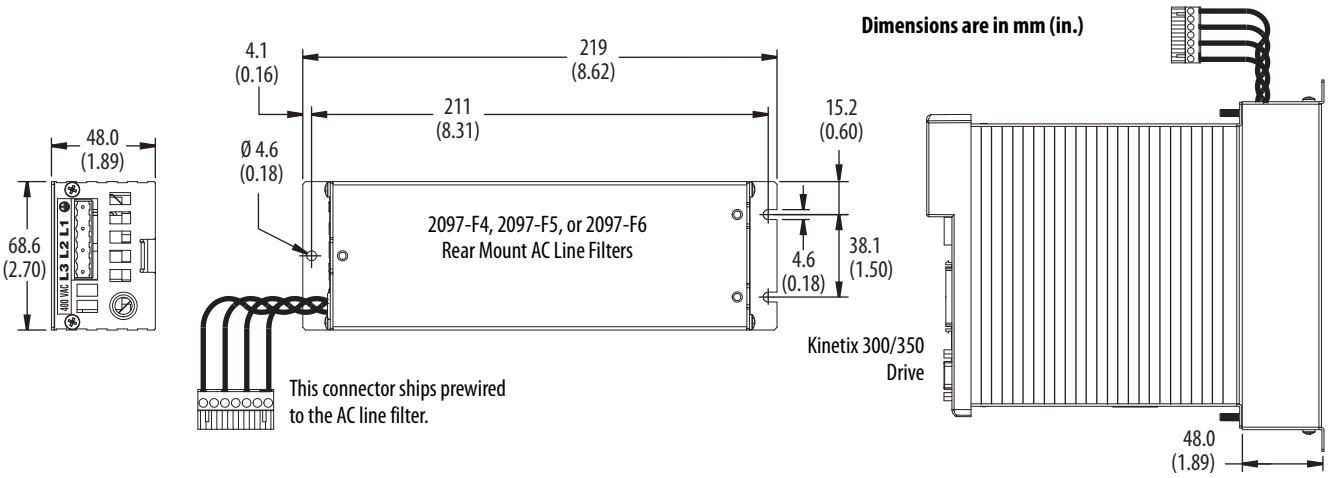
The Kinetix 300/350 drives were tested by using recommended line filters. Use of these filters is also needed to meet CE requirements. The 2097-V32PR0-*xx*, 2097-V32PR2-*xx*, and 2097-V32PR4-*xx* drives have integrated AC line filters.

AC Line Filter Dimensions


Dimensions are in mm (in.)
This connector ships prewired to the AC line filter.
Kinetix 300/350 Drive
2097-F1 or 2097-F2 Side Mount AC Line Filters
150 (5.90)
35.8 (1.41)
166 (6.52)

2097-F1 and 2097-F2 side-mount line filters add 35.8 mm (1.41 in.) to the width of your drive.

2097-F4, 2097-F5, and 2097-F6 rear-mount line filters add 48 mm (1.89 in.) to the depth of your drive.



AC Line Filter Specifications

AC Line Filter Cat. No.	Mount	Voltage 50/60 Hz	Phase	Current A @ 40 °C (104 °F)	Power Loss W	Leakage Current mA	Weight, approx kg (lb)	Kinetix 300/350 [1] Drive Cat. No.
2097-F1	Side	120/240V AC	1	24.0	5.2	9.0	0.6 (0.13)	2097-V33PR6-*xx* [2]
2097-F2		480V AC	3	10.0	2.8	1.0		2097-V34PR6-*xx*
2097-F4 [3]	Rear	120/240V AC	1 or 3	4.40	1.2		0.8 (0.18)	2097-V33PR1-*xx*
		480V AC	3					2097-V34PR3-*xx*
2097-F5 [3]				6.90	1.3			2097-V34PR5-*xx*
		120/240V AC	1 or 3					2097-V33PR3-*xx*
2097-F6 [3]			1	15.0	4.1			2097-V33PR5-*xx*

(1) Use 2090-XXLF-TC116 (single-phase) line filter for 2097-V31PR0-*xx* and 2097-V31PR2-*xx* drives. Use 2090-UXLF-336 line filter for 2097-V33PR5-*xx* (three-phase) drive applications. Refer to the Kinetix Motion Accessories Technical Data, publication GMC-TD004 for more information.

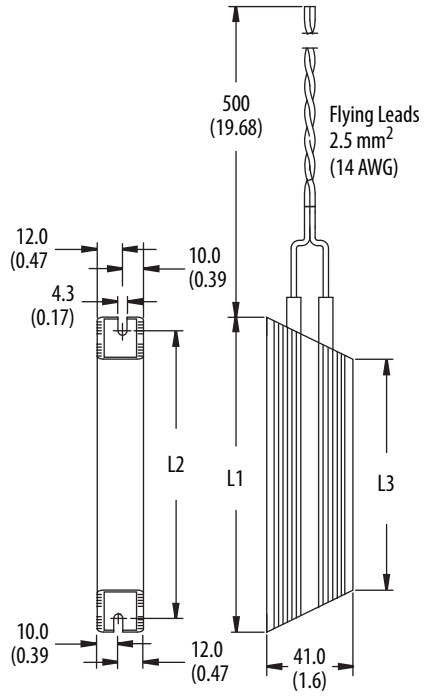
(2) Use the 2097-F1 (single-phase) line filter only for 2097-V33PR6-*xx* (single-phase) drive operation.

(3) This filter is rated for multiple voltage/phase line conditions.

Shunt Resistor

The Bulletin 2097 passive shunt resistor wires directly to the Kinetix 300/350 drive.

Shunt Resistor Dimensions



Dimensions are in mm (in.)

Shunt Resistor Cat. No.	L1	L2	L3
2097-R2	210 (8.3)	197 (7.7)	170 (6.7)
2097-R3	210 (8.3)	197 (7.7)	170 (6.7)
2097-R4	150 (5.9)	137 (5.4)	110 (4.3)
2097-R6	210 (8.3)	197 (7.7)	170 (6.7)
2097-R7	150 (5.9)	137 (5.4)	110 (4.3)

Shunt Resistor Power Specifications

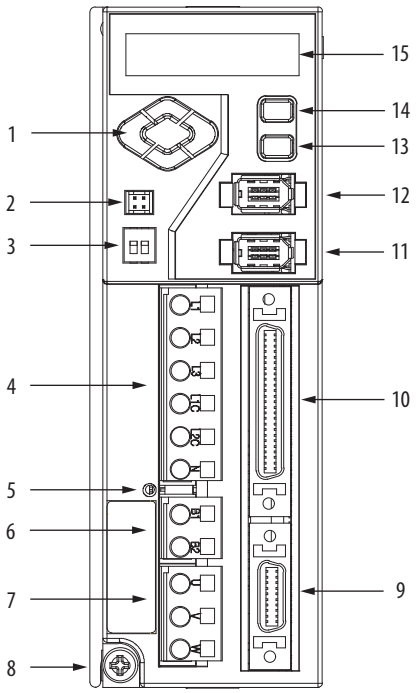
Shunt Module Cat. No.	Resistance Ω	Continuous Power W	Peak Power kW	Peak Current A	D_Application, max (1) %	Weight kg (lb)	Kinetix 300/350 Drive Cat. No.
2097-R2	20	150	7.6	19.5	1.97	0.3 (0.7)	2097-V32PR4-*xx* 2097-V33PR5-*xx*
2097-R3	30		5.1	13.0	2.96		2097-V33PR6-*xx*
2097-R4	40	80	3.8	9.8	2.10	0.2 (0.4)	2097-V31PR0-*xx* 2097-V31PR2-*xx* 2097-V32PR0-*xx* 2097-V32PR2-*xx* 2097-V33PR1-*xx* 2097-V33PR3-*xx*
2097-R6	75	150	7.9	10.3	1.90	0.3 (0.7)	2097-V34PR5-*xx* 2097-V34PR6-*xx*
2097-R7	150	80	4.0	5.1	2.02	0.2 (0.4)	2097-V34PR3-*xx*

(1) D_Application is the application duty cycle in percent. For the intermittent regeneration applications, use D_Application = t/T, where t is the duration when regeneration is needed and T is the time interval between two regenerations. Both t and T must use the same time units, for example, seconds.

Kinetix 3 Component Servo Drives

The Kinetix 3 component servo drive provides a cost-effective motion control solution for smaller, low-axis count applications. By providing the ability to apply the appropriate level of control for the application along with downloadable configuration software and automatic motor recognition, the Kinetix 3 servo drive delivers a motion solution that is easy to use at minimum cost. Its compact size and lower power ranges make it ideal for a variety of applications including indexing tables, medical manufacturing, laboratory automation equipment, and semiconductor processing.

Kinetix 3 Drive Features and Indicators



Item	Description
1	Left/right and up/down keys
2	Analog output (A.out)
3	RS-485 communication termination switch
4	Input power (IPD) connector
5	Main power status indicator
6	Shunt power (BC) connector
7	Motor power (MP) connector
8	Ground lug
9	Motor feedback (MF) connector
10	Input/output (IOD) connector
11	Serial interface (Comm0B) down
12	Serial interface (Comm0A) up
13	Enter key
14	Mode/set key
15	7-segment status indicator

Technical Specifications - Kinetix 3 Component Servo Drives

Kinetix 3 Servo Drive Power Specifications

Attribute	2071-AP0	2071-AP1	2071-AP2	2071-AP4	2071-AP8	2071-A10	2071-A15
AC input voltage	170…264V rms						
AC input phase	Single-phase				Three-phase/ Single-phase	Three-phase	
AC input frequency	47…63 Hz						
Mains AC input current (1) Nom (rms)	1.30 A	2.38 A	3.68 A	7.14 A	6.25 A (three-phase) 10.52 A (single-phase)	8.75 A	12.37 A
Max inrush (0-pk)	21.9 A				22.6 A		
Mains AC line loss ride through	20 ms						
Nominal bus output voltage	311V DC						
Bandwidth (2) Velocity loop Current loop	 550 Hz 2000 Hz						
PWM frequency	10 kHz						
Control power AC input voltage	170…264V rms						
Control power input current Nom (rms) Max inrush (0-pk)	 0.1 A rms 31 A						
Continuous output current (rms)	0.61 A	1.11 A	1.72 A	3.33 A	5.05 A	7.07 A	9.90 A
Continuous output current (0-pk)	0.85 A	1.56 A	2.40 A	4.67 A	7.07 A	9.90 A	13.99 A
Peak output current (rms)	1.80 A	3.30 A	5.10 A	9.90 A	14.99 A	18.88 A	29.69 A
Peak output current (0-pk)	2.55 A	4.67 A	7.21 A	14.0 A	21.21 A	26.70 A	41.99 A
Continuous output power	50 W	100 W	200 W	400 W	800 W	1.0 kW	1.5 kW
Bus overvoltage	405V DC						
Bus undervoltage	190V DC						
Internal shunt resistor	N/A			50 Ω	30 Ω		
Internal shunt Continuous power Peak power	 N/A N/A			 30 W 300 W	 70 W 700 W		
Shunt on	390V DC						
Shunt off	380V DC						
Efficiency	90%						
Bus capacitance	390 µF	780 µF			1170 µF		
Capacitive energy absorption	13 J	26 J			39 J		
Short circuit current rating	100,000 A (rms) symmetrical						

(1) Kinetix 3 drive modules are limited to 1 AC mains power cycling every 2 minutes.

(2) Bandwidth values vary based on tuning parameters and mechanical components.

Fuse/Contactor Specifications

Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. The following fuse examples are recommended for use with Kinetix 3 drives.

Fuse and Contactor Specifications

Drive Cat. No.	AC Input Power [1] [2] [3] Recommended Fuse	Control Power [2] [4] Recommended Fuse	Contactor [5]
2071-AP0	FNQ-R-7	FRS-R-2-1/2 FNQ-R-7-1/2 LPJ-6	100-K05*xy*
2071-AP1			
2071-AP2			100-K09*xy*
2071-AP2	FNQ -R-10		100-K12*xy*
2071-AP8	FNQ-R-20 LPJ-20		100-C16*xy*
2071-A10			
2071- A15	FNQ-R-30 LPJ-30		100-C23*xy*

(1) Fuses specified are Bussmann fuses.
(2) FNQ-R fuses are described as time-delay fuses, Class CC.
(3) LPJ fuses are described as dual-element time-delay fuses, Class J.
(4) FRS-R fuses are described as dual-element time-delay fuses, Class RK5.
(5) For contactors: *x* represents coil voltage, *y* represents the number of contacts.

Power Dissipation Specifications

Use this table to size an enclosure and calculate required ventilation for your Kinetix 3 drive system.

Drive Cat. No.	Usage as % of Rated Power Output (watts)				
	20%	40%	60%	80%	100%
2071-AP0	19.3	20.0	20.6	21.3	22.0
2071-AP1	20.1	21.6	23.1	24.6	26.2
2071-AP2	21.7	24.6	27.6	30.6	33.7
2071-AP4	25.6	31.9	38.4	45.2	52.2
2071-AP8	26.4	32.3	38.6	45.1	52.0
2071-A10	30.9	40.2	50.1	60.5	71.5
2071-A15	37.4	50.1	63.8	78.4	93.9

Weight Specifications

Drive Cat. No.	Weight, approx kg (lb)
2071-AP0	0.70 (1.5)
2071-AP1	0.75 (1.6)
2071-AP2	
2071-AP4	1.0 (2.2)
2071-AP8	1.75 (3.9)
2071-A10	
2071-A15	

Maximum Feedback Cable Lengths

Although motor power and feedback cables are available in standard lengths up to 90 m (295.3 ft), Kinetix 3 drive maximum feedback cable length is 30 m (98.4 ft). These tables assume the use of recommended cables as shown in the Kinetix Motion Accessories Technical Data, publication GMC-TD004.

Maximum Cable Lengths for Compatible Motors and Actuators

Rotary Motor Cat. No.	Incremental/TTL (5V) Encoder m (ft)	Absolute High-resolution (5V) 17-bit Encoder m (ft)
TL-A*xxxx*-B		30 (98.4)
TLY-A*xxxx*-B		
TLY-A*xxxx*-H	30 (98.4)	

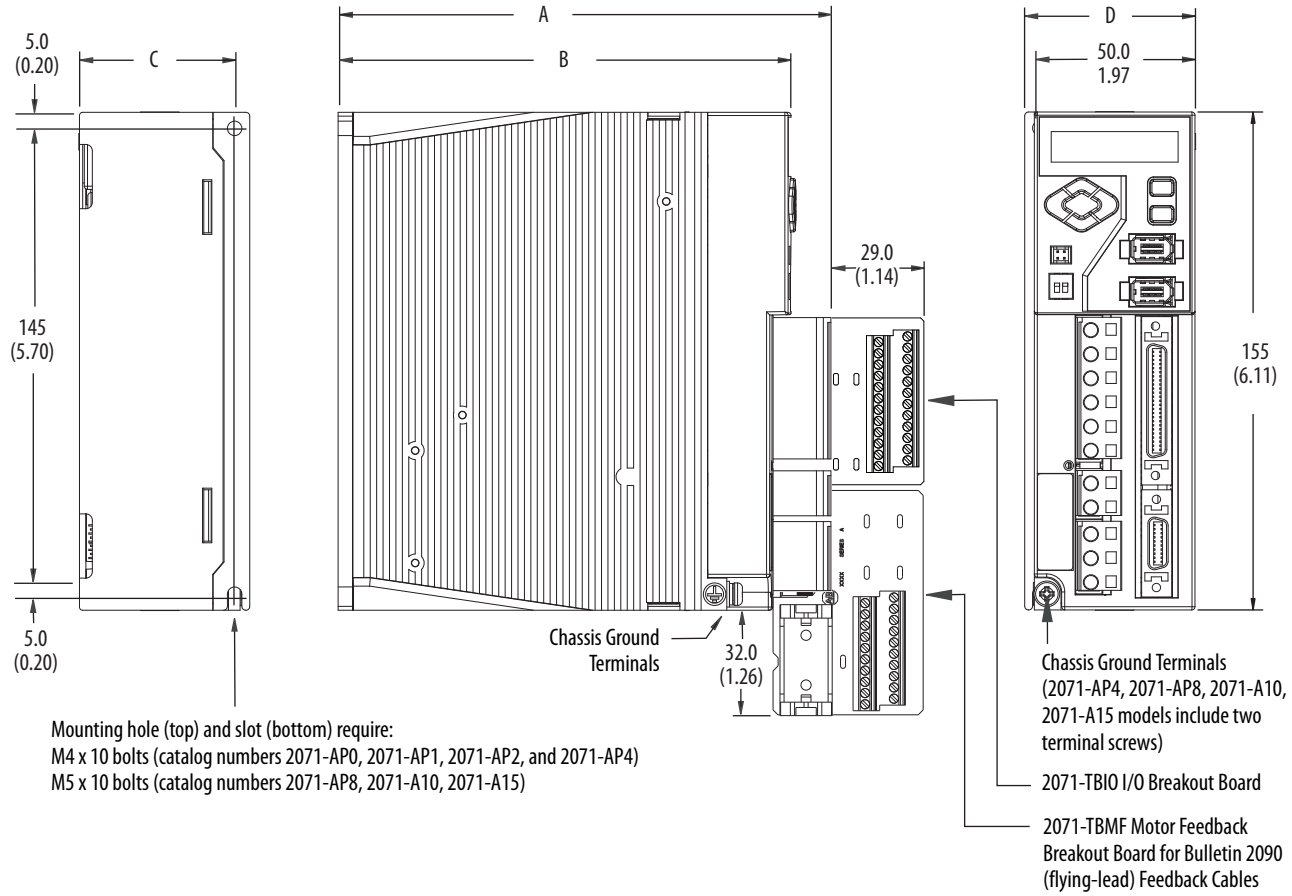
Actuator Cat. No.	Incremental/TTL (5V) Encoder m (ft)	Absolute High-resolution (5V) 17-bit Encoder m (ft)
MPAS-A*xxxx* (direct drive)	30 (98.4)	
TLAR-A*xxxxx*-B		30 (98.4)

Linear Motor Cat. No.	Incremental/TTL (5V) Encoder m (ft)
LDC-Series or LDL-Series	30 (98.4)

Dimensions - Kinetix 3 Component Servo Drives

Dimensions are in mm (in.)

2071-AP0 drive is shown.



Kinetix 3 Drive Dimensions

Drive Cat. No.	A mm (in.)	B mm (in.)	C mm (in.)	D mm (in.)
2071-AP0	153 (6.04)	141 (5.55)	48.3 (1.90)	53.0 (2.09)
2071-AP1				
2071-AP2				
2071-AP4				58.0 (2.29)
2071-AP8	198 (7.82)	186 (7.33)	59.0 (2.32)	81.0 (3.19)
2071-A10				
2071-A15				

Environmental Specifications - Kinetix 3 Component Servo Drives

Attribute	Operational Range	Storage Range (nonoperating)
Temperature, ambient	0…50 °C (32…122 °F)	-25…85 °C (-13…185 °F)
Relative humidity	5…95% noncondensing	5…95% noncondensing
Altitude	1000 m (3281 ft) 3000 m (9843) with derating	3000 m (9843 ft) during transport
Vibration	5…55 Hz @ 0.35 mm (0.014 in.) double amplitude, continuous displacement; 55…500 Hz @ 2.0 g peak constant acceleration (10 sweeps in each of 3 mutually perpendicular directions)	
Shock	15 g, 11 ms half-sine pulse (3 pulses in each direction of 3 mutually perpendicular directions)	

Certifications - Kinetix 3 Component Servo Drives

Certification (1) (when product is marked)	Standards
c-UL-us	UL Listed to U.S. and Canadian safety standards (UL 508 C File E59272).
	This drive provides integral solid state short circuit protection, but does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes. This drive provides solid state motor overload protection that is adjustable. Refer to the Kinetix 3 Component Servo Drives User Manual, publication 2071-UM001, for more information.
CE	European Union 2004/108/EC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC Product Standard including specific test methods.
	European Union 2006/95/EC Low Voltage Directive compliant with EN 61800-5-1:2007 - Adjustable speed electrical power drive systems.
C-Tick	Australian Radio Communications Act, compliant with: • Radio Communications Act: 1992 • Radio Communications (Electromagnetic Compatibility) Standard: 1998 • Radio Communications (Compliance Labelling - Incidental Emissions) Notice: 1998 • AS/NZS CISPR 11: 2003 (Group 2, Class A)
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3 • Registration number: KCC-REM-RAA-2071-A15 • Registration number: KCC-REM-RAA-2071-AP4

(1) Refer to http://www.ab.com for Declarations of Conformity Certificates.

Accessories - Kinetix 3 Component Drives

Kinetix 3 drive accessories include drive-mounted 20-pin and 50-pin breakout boards for making flying-lead motor feedback and I/O connections. For control and configuration serial interface cable specifications, refer to the Kinetix Motion Accessories Technical Data, publication GMC-TD004.

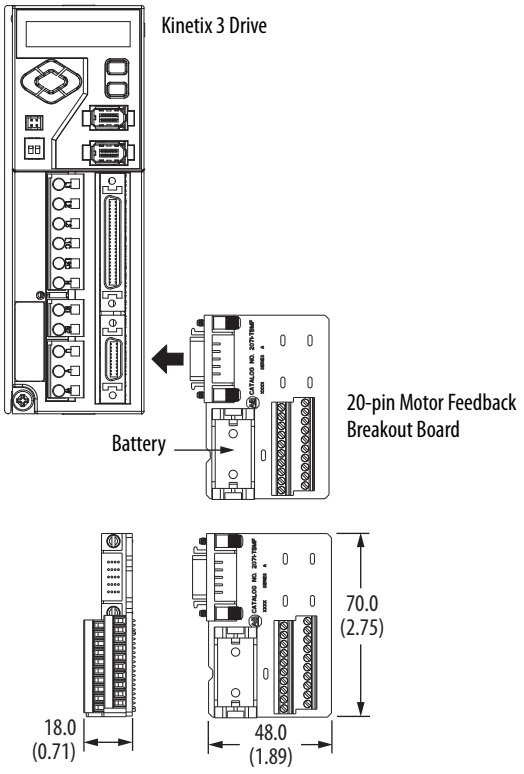
Motor Feedback Breakout Board

Use the 2071-TBMF breakout board with 2090-CFBM6DF-CBAA*xx* flying-lead feedback cables or when your motor or actuator has high-resolution encoder feedback.

Motor Feedback Breakout Board Specifications

Attribute	Value
Wire size	1.5…0.2 mm^2 (16…24 AWG)
Change in depth of drive (1)	29 mm (1.14 in.)
Change in height of drive (1)	32 mm (1.26 in.)

(1) Add this value to the dimensions of your Kinetix 3 drive. Refer to Dimensions - Kinetix 3 Component Servo Drives on page 55.



Dimensions are in mm (in.)

The customer-supplied 3.6V lithium battery, when installed in a motor feedback breakout board, provides multi-turn encoder operation to TL-Series™ (Bulletin TL, TLY, and TLAR) motors and actuators.

Battery Specifications

Attribute	Value
International size reference	1/2AA, ER14252
Capacity, nom @ 0.5 mA, to 2V	1.2 Ah
Rated voltage	3.6V
Recommended continuous current, max	50 mA

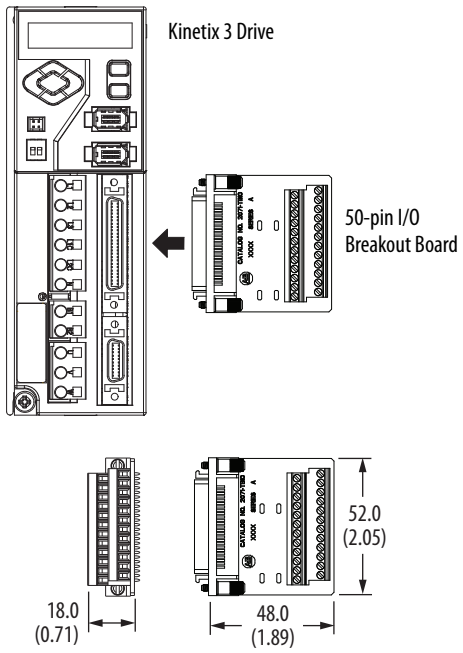
I/O Breakout Board

Use the 2071-TBIO breakout board for making flying-lead cable connections to twenty-four of the most commonly used terminals in the 50-pin IOD connector.

I/O Breakout Board Specifications

Attribute	Value
Wire size	1.5…0.2 mm^2 (16…24 AWG)
Change in depth of drive (1)	29 mm (1.14 in.)

(1) Add this value to the dimensions of your Kinetix 3 drive. Refer to Dimensions - Kinetix 3 Component Servo Drives on page 55.



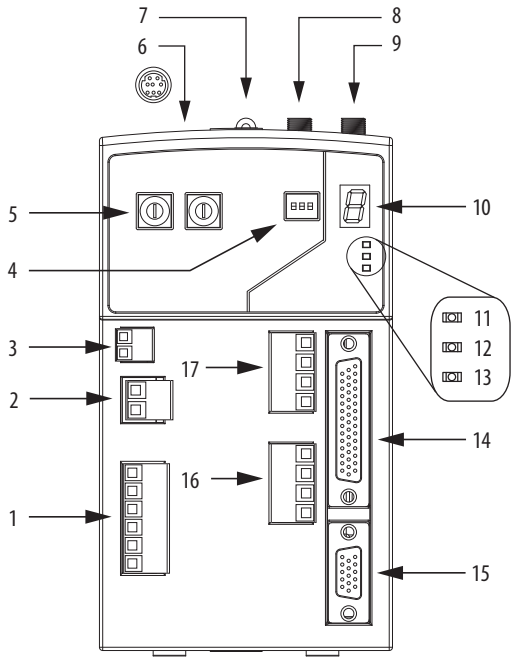
Kinetix 2000 Multi-axis Servo Drives

Extend the benefits of Kinetix Integrated Motion to low-power motion control applications with the Kinetix 2000 servo drive. This multi-axis servo drive provides simplicity at its best, letting you save time and money from initial wiring and programming to operation and diagnostics. With a continuous output current (rms) from 1.0...9.5 amps, the Kinetix 2000 drive offers the same compact design, exceptional performance, and cost saving features as the Kinetix 6000 drives. The commonality among the Kinetix drives allows you to learn once and reuse your product knowledge. Paired with the CompactLogix™ 1768-L4*x* controller, the Kinetix 2000 drive is ideal for small and mid-sized applications looking to improve productivity, quality, and time to market while reducing the total cost of ownership.

The Kinetix 2000 servo drives provide Integrated Motion capability through the sercos interface and are part of the Kinetix Integrated Motion solution.

Kinetix 2000 Features and Indicators

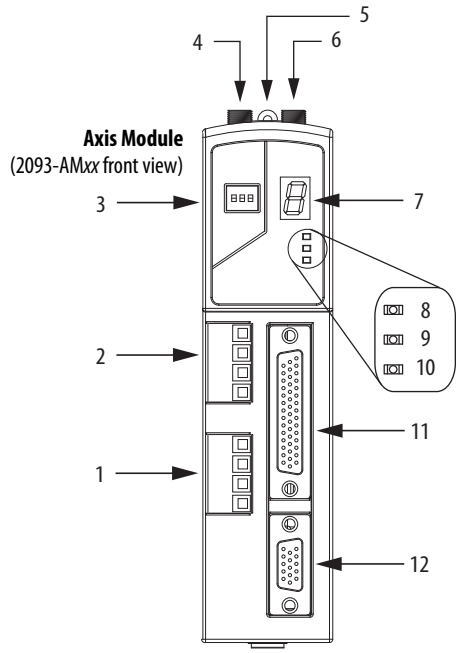
2093-AC05-MP*x* IAM Features and Indicators



Integrated Axis Module
(2093-AC05-MP*x* front view)

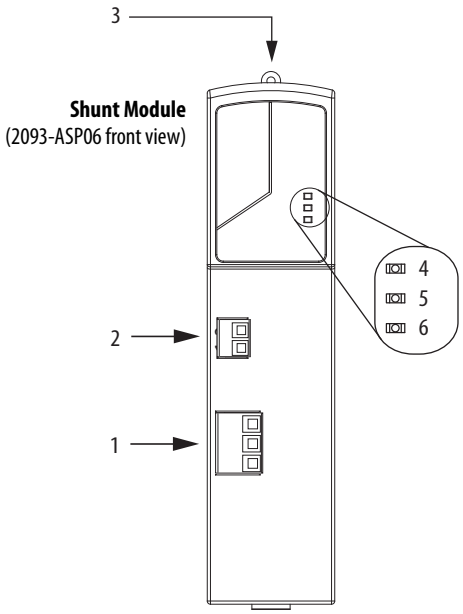
Item	Description
1	DC Bus / AC input power (IPD) connector
2	Control power (CPD) connector
3	Contactor enable (CED) connector
4	Sercos communication rate and optical power switches
5	Sercos node address switch
6	DPI connector (facing up)
7	Mounting screw
8	Sercos receive (Rx) connector
9	Sercos transmit (Tx) connector
10	Seven-segment fault status indicator
11	Drive status indicator
12	COMM status indicator
13	Bus status indicator
14	I/O and auxiliary feedback (IOD/AF) connector
15	Motor feedback (MF) connector
16	Motor power (MP) connector
17	Motor brake (BC) connector

2093-AM*xx* AM Features and Indicators



Item	Description
1	Motor power (MP) connector
2	Motor brake (BC) connector
3	Sercos communication rate and optical power switches
4	Sercos receive (Rx) connector
5	Mounting screw
6	Sercos transmit (Tx) connector
7	Seven-segment fault status indicator
8	Drive status indicator
9	COMM status indicator
10	Bus status indicator
11	I/O and auxiliary feedback (IOD/AF) connector
12	Motor feedback (MF) connector

2093-ASP06 Shunt Module Features and Indicators



Item	Description
1	External shunt resistor (RC) connector
2	External thermal switch (TS) connector
3	Mounting screw
4	Shunt fault status indicator
5	Over-temp fault status indicator
6	Bus status indicator

Technical Specifications - Kinetix 2000 Multi-axis Servo Drives

The converter section of these modules is identical. Choose your IAM module based on the inverter requirements of your application.

IAM Module (three-phase and single-phase) Power Specifications

Attribute	2093-AC05-MP*x* Three-phase Input (230V nom)	2093-AC05-MP*x* Single-phase Input (230V nom)
AC input voltage	170…264V rms	
AC input frequency	47…63 Hz	
Main AC input current (1)		
Nom (rms)	11.66 A	10.95 A
Max inrush (0-pk)	34.0 A	34.0 A
DC input voltage (common bus follower)	240…375V DC	
DC input current (common bus follower)	9.76 A	6.42 A
Control power AC input voltage	170…264V rms, single-phase (230V nom)	
Control power AC input current		
Nom (@ 230V AC) rms	1.25 A	
Max inrush (0-pk)	93.0 A (2)	
Nominal bus output voltage	325V DC	
Line loss ride through	20 ms	
Continuous output current to bus (A_{DC})	9.67 A	6.42 A
Peak output current to bus (A_{DC}) (3)	19.34 A	12.84 A
Bus overvoltage	415V DC	
Bus undervoltage	135.5V DC	
Internal shunt		
Continuous power	15 W	
Peak power	3000 W	
Internal shunt resistor	50 Ω	
Shunt on	405V	
Shunt off	375V	
Continuous power output to bus	3.0 kW	2.0 kW
Peak power output	6.0 kW	4.0 kW
Efficiency	95%	
Converter inductance	N/A	
Converter capacitance	540 µF	
Converter leakage current (max)	2.0 mA	

(1) All 2093-AC05 integrated axis modules are limited to 2 contactor cycles per minute (with up to 4 axis modules), or 1 contactor cycle per minute (with 5…8 axis modules).
(2) Maximum inrush duration is less than 1/2 line cycle.
(3) Peak output current duration equals 250 ms.

Control Power Current Requirements

Modules on Power Rail	220/230V AC Input A	Input VA VA
IAM only	0.15	50
IAM, 1 AM	0.30	99
IAM, 2 AM	0.45	148
IAM, 3 AM	0.60	197
IAM, 4 AM	0.75	247
IAM, 5 AM	0.90	296
IAM, 6 AM	1.05	345
IAM, 7 AM	1.20	395
IAM, 7 AM, 1 Shunt module	1.25	410

These specifications apply to the axis module specified in the column heading by catalog number and the same axis module (inverter section) that resides within an integrated axis module.

AM Module Power Specifications

Attribute	2093-AMP1 (2093-AC05-MP1)	2093-AMP2 (2093-AC05-MP2)	2093-AMP5 (2093-AC05-MP5)	2093-AM01	2093-AM02
Bandwidth [1] Velocity Loop Current Loop	 500 Hz 1300 Hz				
PWM frequency	8 kHz				
Nominal input voltage	325V DC				
Continuous current (rms)	1.0 A	2.0 A	3.0 A	6.0 A	9.5 A
Continuous current (0-pk)	1.41 A	2.83 A	4.24 A	8.48 A	13.4 A
Peak current (rms)	3.0 A	6.0 A	9.0 A	18.0 A	28.5 A
Peak current (0-pk)	4.20 A	8.48 A	12.7 A	25.5 A	40.3 A
Peak output current time (max)	3 s from 0% drive utilization (0% soak)				
Continuous power out (nom)	0.3 kW	0.6 kW	0.9 kW	1.9 kW	3.0 kW
Efficiency	98%				
Capacitance	200 µF			540 µF	
Capacitive energy absorption	7.5 J			20 J	
Inverter PCB leakage current	1 mA				

(1) Bandwidth values vary based on tuning parameters and mechanical components.

Circuit Breaker/Fuse Specifications

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses.

Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. Evaluation of the short-circuit available current is critical and must be kept below the short-circuit current rating of the circuit breaker.

Use class CC, J, L, or R fuses, with current rating as indicated in the table below. The following fuse examples and Allen-Bradley circuit breakers are recommended for use with the 2093-*x*C*xx*-M*xx* IAM modules when the Line Interface Module (LIM) is not used.

IMPORTANT 2094-AL*xx*S and 2094-XL75S-C2 LIM modules provide branch circuit protection to the IAM module. Follow all applicable NEC and local codes.

Fuse Specifications

Drive Cat. No.	V AC Input Power				Control Input Power		DC Common Bus
	Input Voltage	Bussmann Fuse	Allen-Bradley Circuit Breaker		Bussmann Fuse	Allen-Bradley Circuit Breaker	Ferraz Shawmut Fuse
2093-AC05-MP1	170…264 AC three-phase	KTK-R-20 (20 A)	1492-SP3D300	140M-F8E-C16	FNQ-R-10 (10 A) Class CC or LPJ-10SP (10 A) Class J	1492-CB2H060	A50P20-1
2093-AC05-MP2							
2093-AC05-MP5							
2093-AC05-MP1	170…264 AC single-phase	KTK-R-20 (20 A)	1492-SP2D300	N/A			A50P20-1
2093-AC05-MP2							
2093-AC05-MP5							

Contactor Ratings

The table below lists the recommended contactor ratings for integrated axis modules installed without a line interface module.

IAM Cat. No.	Input Voltage	Contactor
2093-AC05-MP1	170…264 AC single-phase or three-phase operation	100-C23x10 (AC coil) 100-C23Zx10 (DC coil)
2093-AC05-MP2		
2093-AC05-MP5		

Transformer Specifications for Control Power Input

You can use any general purpose transformer with these ratings.

Attribute	Value
Input volt-amperes	500VA
Output voltage	200…240V AC

Power Dissipation Specifications

Use this table to size an enclosure and calculate required ventilation for your Kinetix 2000 drive system.

Kinetix 2000 Modules		Usage as % of Rated Power Output (watts)				
		20%	40%	60%	80%	100%
Integrated Axis Module (IAM Converter) (1)						
2093-AC05-MP1	Three-phase input	7.0	10.5	14.0	17.4	20.9
2093-AC05-MP2						
2093-AC05-MP5						
2093-AC05-MP1	Single-phase input	5.8	8.0	10.3	12.6	14.8
2093-AC05-MP2						
2093-AC05-MP5						
Integrated Axis Module (IAM Inverter) or Axis Module (AM) (1)						
2093-AC05-MP1 or 2093-AMP1		31.6	33.6	35.6	37.6	39.6
2093-AC05-MP2 or 2093-AMP2		33.0	36.4	39.8	43.3	46.8
2093-AC05-MP5 or 2093-AMP5		36.2	42.9	49.8	56.8	63.9
2093-AM01		38.3	46.7	55.3	64.1	73.1
2093-AM02		44.3	55.6	67.3	79.2	91.4
Shunt Module						
2093-ASP06		35.8	45.8	55.8	65.8	75.8

(1) Internal shunt power is not included in the calculations and must be added based on utilization.

Weight Specifications

Kinetix 2000 Module	Cat. No.	Weight, approx kg (lb)
IAM	2093-AC05-MP1	1.32 (2.9)
	2093-AC05-MP2	
	2093-AC05-MP5	
AM	2093-AMP1	0.67 (1.5)
	2093-AMP2	
	2093-AMP5	
	2093-AM01	0.95 (2.1)
	2093-AM02	
Shunt module	2093-ASP06	0.59 (1.3)

Kinetix 2000 Module	Cat. No.	Weight, approx kg (lb)
Power Rails (Slim)	2093-PRS1	0.27 (0.6)
	2093-PRS2	0.38 (0.8)
	2093-PRS3	0.51 (1.1)
	2093-PRS4	0.64 (1.4)
	2093-PRS5	0.77 (1.7)
	2093-PRS7	1.03 (2.3)
	2093-PRS8S	1.28 (2.8)
Slot-filler module	2093-PRF	0.15 (0.3)

Maximum Feedback Cable Lengths

Although motor feedback cables are available in standard lengths up to 90 m (295.3 ft), the Kinetix 2000 drive maximum feedback cable length is 30 m (98.4 ft). These tables assume the use of recommended cables as shown in the Kinetix Motion Accessories Technical Data, publication GMC-TD004.

Cable Lengths for Compatible Rotary Motors

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)	Absolute High-resolution (5V) 17-bit Encoder m (ft)
MPL-A3*xxx*… MPL-A5*xxx*-S/M (1)	30 (98.4)		
MPL-A15*xxx*… MPL-A2*xxx*-E/V	30 (98.4)		
MPL-A15*xxx*… MPL-A45*xxx*-H		30 (98.4)	
MPM-A*xxxxx*-S/M	30 (98.4)		
MPF-A*xxxx*-S/M (1)	30 (98.4)		
MPS-A*xxxx*-S/M	30 (98.4)		
TLY-A*xxxx*-B			30 (98.4)
TLY-A*xxxx*-H		30 (98.4)	

(1) MPL-A5*xxx* and MPF-A5*xxx* motor encoders are rated for 9V, the remaining Bulletin MPL and MPF (200V-class) motor encoders are rated for 5V.

Cable Lengths for Compatible Linear Actuators

Actuator Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)	Absolute High-resolution (5V) 17-bit Encoder m (ft)
MPMA-A*xxxxx* or MPAS-A*xxxxx*-V (ballscrew)	30 (98.4)		
MPMA-A*xxxxx* or MPAS-A*xxxxx*-A (direct drive)		30 (98.4)	
MPAR-A*xxxxx*-V/M	30 (98.4)		
TLAR-A*xxxxx*-B			30 (98.4)
MPAI-A*xxxxx*M3	30 (98.4)		

Cable Lengths for Compatible Linear Motors

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)
LDC-Series or LDL-Series	30 (98.4)	30 (98.4)

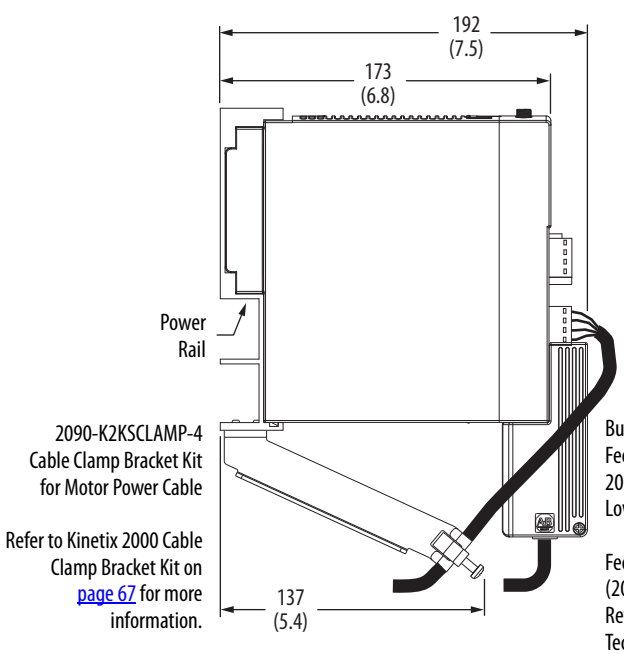
Maximum Power Cable Length

Although motor power cables are available in standard lengths up to 90 m (295.3 ft) and the Kinetix 2000 power rail is available in sizes up to eight axes, to meet CE requirements and improve system performance the combined motor power length for all axes on the same DC bus must not exceed 160 m (525 ft).

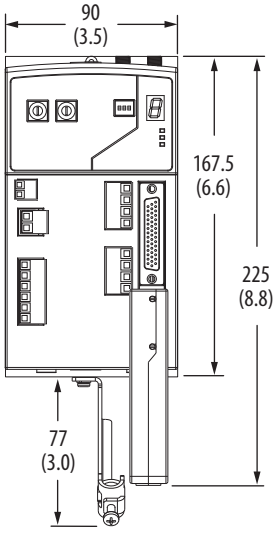
IMPORTANT Operating the Kinetix 2000 drive at maximum temperature with maximum cable length may necessitate derating of the drive.

Dimensions - Kinetix 2000 Multi-axis Servo Drives

2093-AC05-MP1, 2093-AC05-MP2, and 2093-AC05-MP5 Dimensions



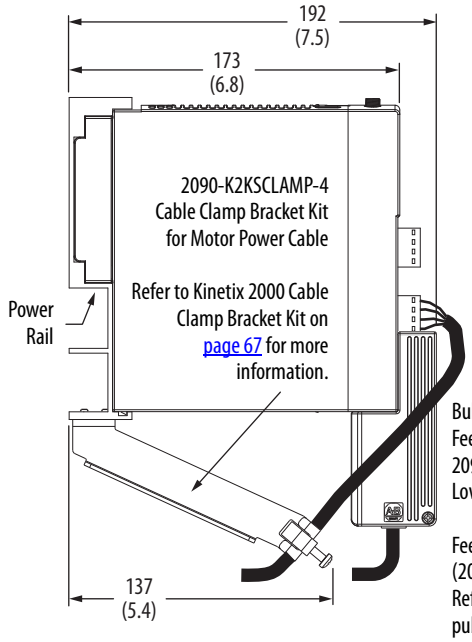
Dimensions are in mm (in.)



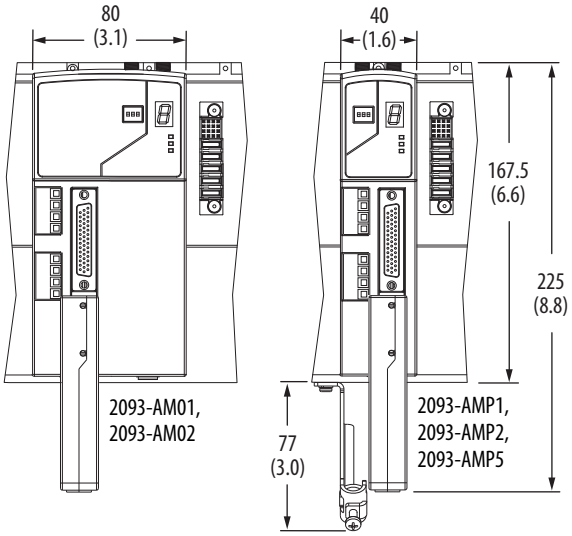
Important: Additional clearance below the connectors is necessary to provide the recommended cable bend radius.

Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

2093-AMP1, 2093-AMP2, 2093-AMP5, 2093-AM01, and 2093-AM02 Dimensions



Dimensions are in mm (in.)



Important: Additional clearance below the connectors is necessary to provide the recommended cable bend radius.

Modules are shown mounted to the power rail and the dimensions reflect that in the depth of the module.

Environmental Specifications - Kinetix 2000 Multi-axis Servo Drives

Attribute	Operational Range	Storage Range (nonoperating)
Temperature, ambient	0…50 °C (32…122 °F)	-40…85 °C (-40…185 °F)
Relative humidity	5…95% noncondensing	5…95% noncondensing
Altitude	1000 m (3281 ft) 3000 m (9843 ft) with derating	3000 m (9843 ft) during transport
Vibration	5…55 Hz @ 0.35 mm (0.014 in.) double amplitude, continuous displacement; 55…500 Hz @ 2.0 g peak constant acceleration (10 sweeps in each of 3 mutually perpendicular directions)	
Shock	15 g, 11 ms half-sine pulse (3 pulses in each direction of 3 mutually perpendicular directions)	

Certifications - Kinetix 2000 Multi-axis Servo Drives

Agency Certification (1)	Standards
c-UL-us	UL Listed to U.S. and Canadian safety standards (UL 508C File E59272).
CE	European Union 2004/108/EC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC Product Standard including specific test methods.
	European Union 2006/95/EC Low Voltage Directive compliant with EN 50178:1997 - Electronic Equipment for use in Power Installations.
C-Tick	Australian Radio Communications Act, compliant with: • Radio Communications Act: 1992 • Radio Communications (Electromagnetic Compatibility) Standard: 1998 • Radio Communications (Compliance Labelling - Incidental Emissions) Notice: 1998 • AS/NZS CISPR 11: 2003 (Group 2, Class A)
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3 • Registration number: KCC-REM-RAA-2093-AC05-MP5 • Registration number: KCC-REM-RAA-2093-ASP06

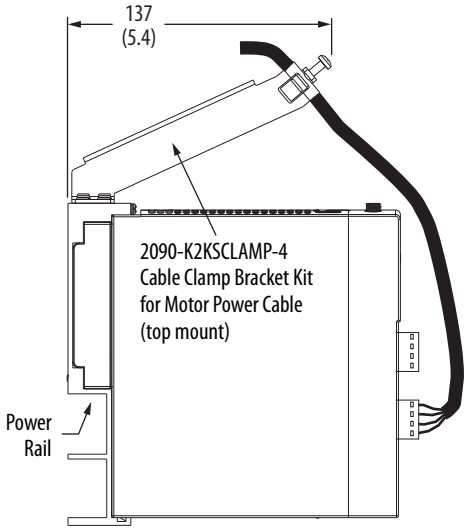
(1) When product is marked, refer to http://www.ab.com for Declarations of Conformity Certificates.

Accessories - Kinetix 2000 Multi-axis Servo Drives

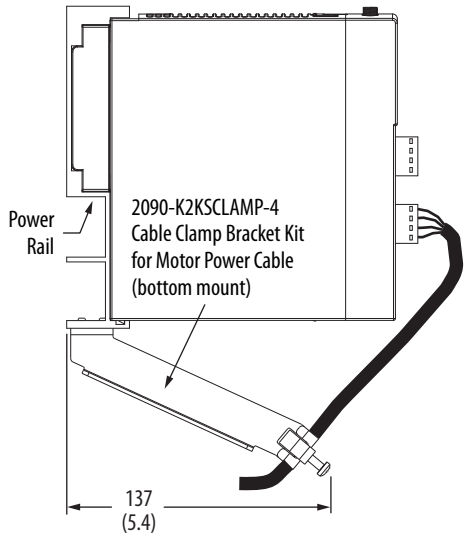
Kinetix 2000 Cable Clamp Bracket Kit

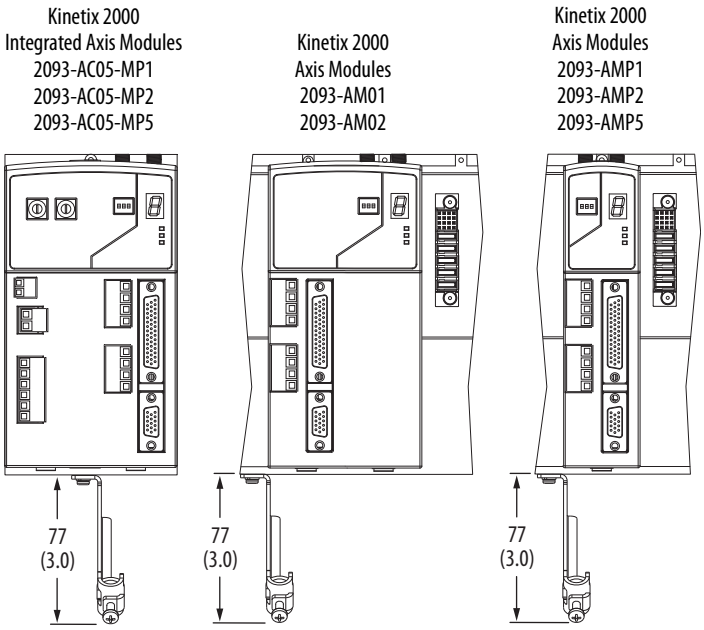
The cable clamp bracket kit (catalog number 2090-K2KSCLAMP-4) is designed for use with the Kinetix 2000 IAM and AM drive modules. The clamp mounts to the power rail and provides stress relief for the motor power cable and an electrical path from the cable shield to machine ground. You can mount the bracket to the top or bottom of the power rail, depending on the layout of cables within your panel.

Cable Clamp Bracket Kit (catalog number 2090-K2KSCLAMP-4)



Dimensions are in mm (in.)





IMPORTANT: Additional clearance below the connector is necessary to provide the recommended cable bend radius.

Kinetix 2000 Power Rail

Kinetix 2000 IAM, AM, and Shunt Module Slot Requirements

IAM Cat. No.	Converter Slot Used	Inverter Slots Used
2093-AC05-MP1	1	1
2093-AC05-MP2		1
2093-AC05-MP5		1

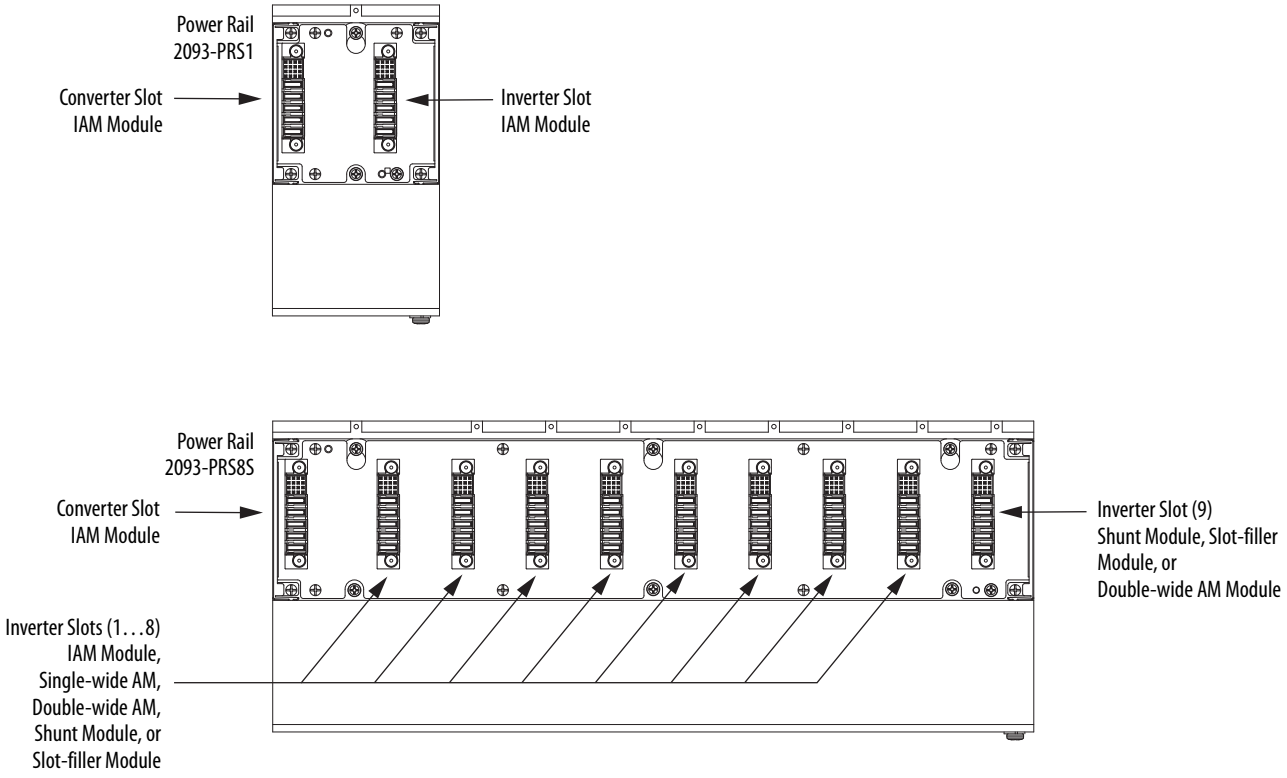
AM Cat. No.	Converter Slot Used	Inverter Slots Used
2093-AMP1	0	1
2093-AMP2		1
2093-AMP5		1
2093-AM01		2 (1)
2093-AM02		2

Shunt Module Cat. No.	Converter Slot Used	Inverter Slots Used
2093-ASP06	0	1

(1) 2093-AM01 and 2093-AM02 axis modules are double-wide modules and require two slots on the power rail.

The far-left slot on each power rail is the converter slot and used only by the IAM. All other slots are inverter slots and are used by the IAM, AM, or shunt module (refer to the figure below). The power rail catalog number indicates the maximum number axes that each power rail will hold.

Power Rail Slots



For example, the 2093-PRS1 power rail contains one inverter slot. This limits the use of this power rail to systems requiring only one inverter slot. Similarly, the 2093-PRS2 power rail contains two inverter slots. This limits the use of this power rail to systems requiring up to two inverter slots. When selecting a power rail, determine the number of inverter slots required by all rail-mounted modules and choose a power rail with that minimum number of inverter slots.

IMPORTANT If you select a power rail with slots exceeding the minimum required for your system, you must install a 2093-PRF slot-filler module in each unused slot.

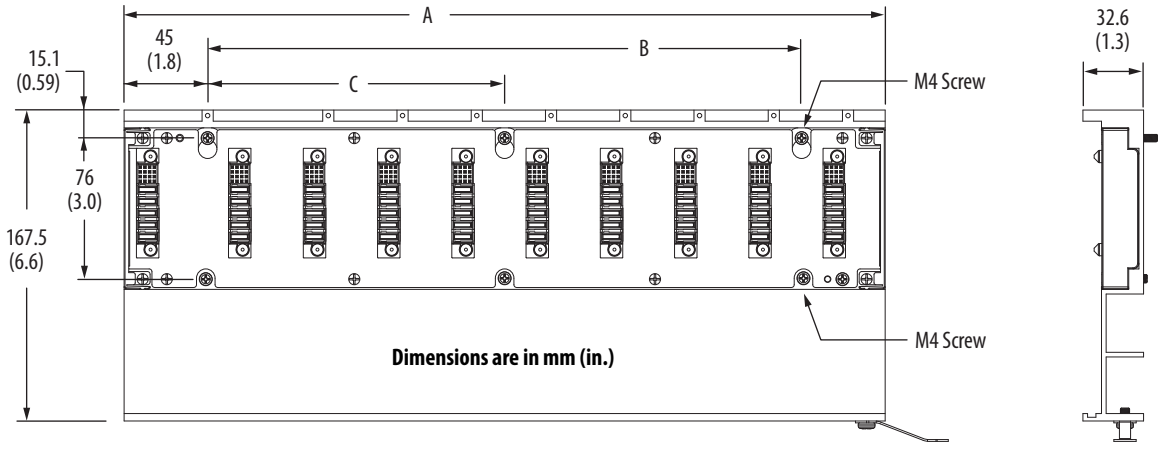
The 2093-PRS8S power rail is unique in that it accommodates eight axes, but has nine inverter slots. The far-right (ninth) inverter slot is reserved for a shunt module, but could also be occupied by a slot-filler module or double-wide axis module. These power rail configurations are supported.

2093-PRS8S Configurations

8-axis		7-axis		6-axis		5-axis		
IAM	IAM	IAM	IAM	IAM	IAM	IAM	IAM	IAM
AM	AM	AM (double-wide)	AM (double-wide)	AM (double-wide)	AM (double-wide)	AM (double-wide)	AM (double-wide)	AM (double-wide)
AM	AM							
AM	AM	AM	AM	AM (double-wide)	AM (double-wide)	AM (double-wide)	AM (double-wide)	AM (double-wide)
AM	AM	AM	AM					
AM	AM	AM	AM	AM	AM	AM (double-wide)	AM (double-wide)	AM (double-wide)
AM	AM	AM	AM	AM	AM			
AM	AM	AM	AM	AM	AM	AM (double-wide)	AM	AM
Shunt module	Slot-filler module	Shunt module	Slot-filler module	Shunt module	Slot-filler module		Shunt module	Slot-filler module

IMPORTANT The maximum number of axes supported by the 2093-PRS8S power rail is eight axes. Do not install an axis module (AM) in the far-right (ninth) inverter slot.

2093-PRS1, 2093-PRS2, 2093-PRS3, 2093-PRS4, 2093-PRS5, 2093-PRS7, and 2093-PRS8S Dimensions



Power Rail Cat. No.	Description	Dimension A mm (in.)	Dimension B mm (in.)	Dimension C mm (in.)
2093-PRS1	1 axis power rail	90 (3.54)	N/A	N/A
2093-PRS2	2 axis power rail	130 (5.12)	40 (1.57)	N/A
2093-PRS3	3 axis power rail	170 (6.69)	80 (3.15)	N/A
2093-PRS4	4 axis power rail	210 (8.26)	120 (4.72)	N/A
2093-PRS5	5 axis power rail	250 (9.84)	160 (6.30)	N/A
2093-PRS7	7 axis power rail	330 (12.99)	240 (9.45)	120 (4.72)
2093-PRS8S	8 axis power rail	410 (16.14)	320 (12.60)	160 (6.30)

Kinetix 2000 Shunt Module

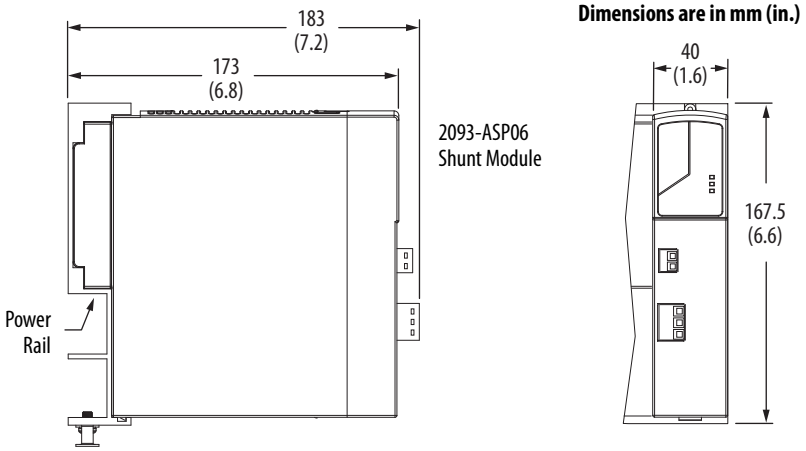
This section contains specifications, mounting dimensions, and catalog numbers for the 2093-ASP06 Shunt Module.

Shunt Module Power Specifications

Drive Cat. No.	Shunt Module Cat. No.	Drive Voltage V AC	Resistance Ω	Peak Power kW	Peak Current A	Continuous Power W	Capacitance µF	Fuse Replacement
2093-AC05-MP1	2093-ASP06	230	15.0	10.9	27.0	50	164	N/A (no internal fuse)
2093-AC05-MP2								
2093-AC05-MP5								

For more information on external shunt resistors compatible with the Kinetix 2000 drive, refer to the Kinetix Motion Accessories Technical Data, publication GMC-TD004.

Shunt Module Dimensions



Modules are shown mounted to the power rail and the dimensions reflect that.

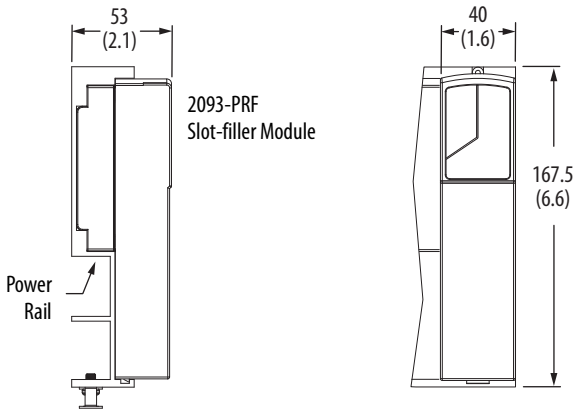
Kinetix 2000 Slot-filler Module

This section contains dimensions and catalog numbers for the 2093-PRF slot-filler module.

IMPORTANT	The Kinetix 2000 slot-filler module (catalog number 2093-PRF) is compatible with all Kinetix 2000 systems. Power rail slots not occupied by an IAM, AM, or shunt module, must have a slot-filler module installed.

Slot-filler Module Dimensions

Dimensions are in mm (in.)



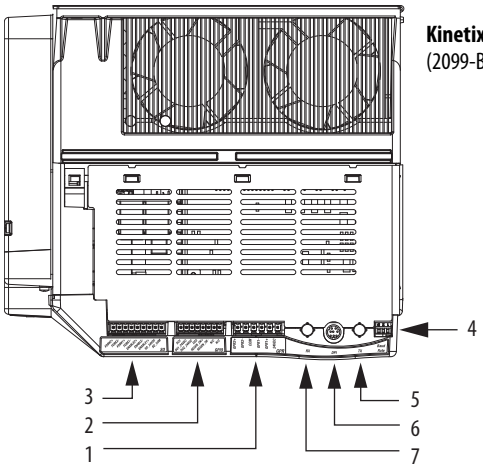
Kinetix 7000 High Power Servo Drives

The Kinetix 7000 high power servo drive is designed to accommodate the most demanding requirements and extends the benefits of Kinetix Integrated Motion to applications up to 149 kW. The Kinetix 7000 high power drive supports three-phase AC input power (380...480V AC) and DC input for common bus applications. In addition, the safe-off capability integrated into this drive increases productivity by allowing manufacturers and machine builders to implement machine solutions that provide both safety and maximum machine availability.

The Kinetix 7000 servo drives provide Integrated Motion capability through the sercos interface and are part of the Kinetix Integrated Motion solution.

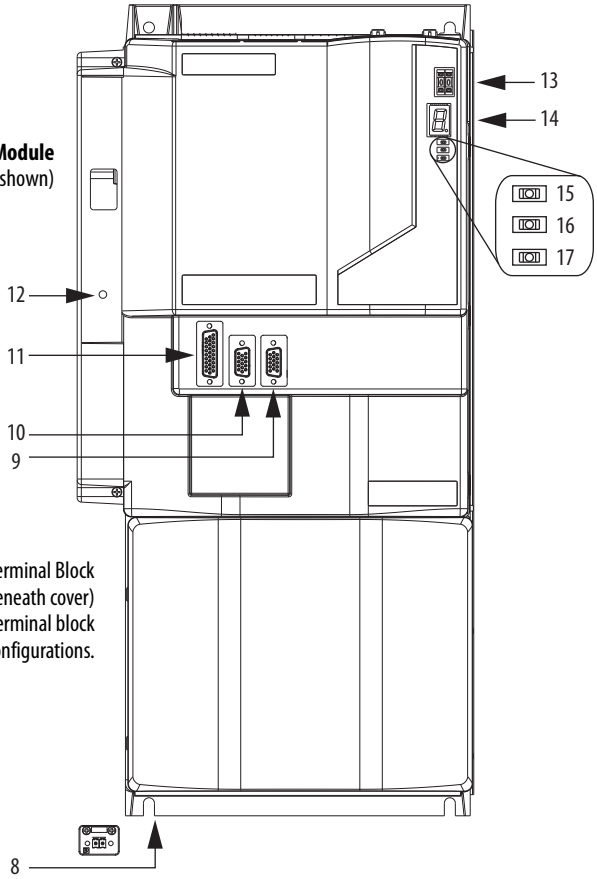
Kinetix 7000 Servo Drive Features and Indicators

Kinetix 7000 Drive Features and Indicators



Kinetix 7000 Drive Module
(2099-BM07-S top view is shown)

Kinetix 7000 Drive Module
(2099-BM07-S front view is shown)



Power Terminal Block
(beneath cover)
Refer to page 74 for terminal block configurations.

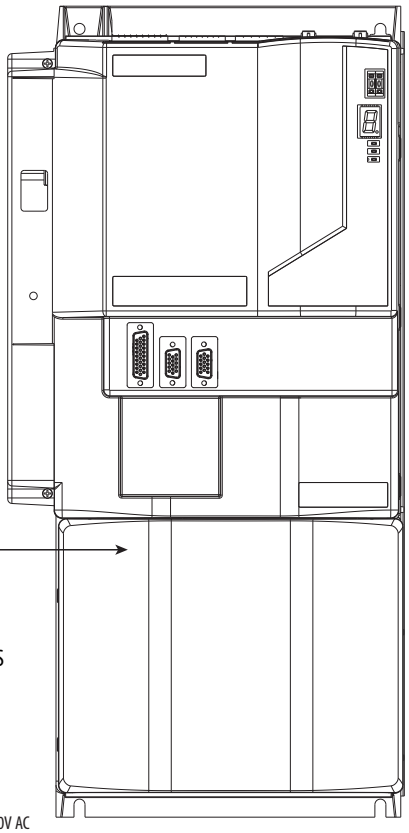
Item	Description
1	General purpose (GPR) connector
2	General purpose (GPIO) connector
3	Safe-off (SO) connector
4	Sercos communication rate and optical power switches
5	Sercos transmit (Tx) connector
6	DPI connector

Item	Description
7	Sercos receive (Rx) connector
8	Control power (CP) connector (facing down)
9	Auxiliary feedback (AF) connector
10	Motor feedback (MF) connector
11	I/O (IOD) connector
12	Control power status indicator

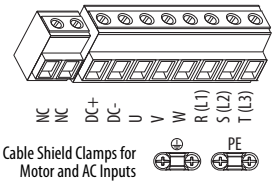
Item	Description
13	Sercos node address switches
14	Seven-segment fault status indicator
15	Drive status indicator
16	COMM status indicator
17	Bus status indicator

Kinetix 7000 Power Terminal Blocks

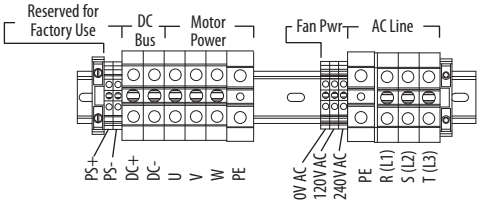
Kinetix 7000 Drive Module, front view
(2099-BM07-S is shown)



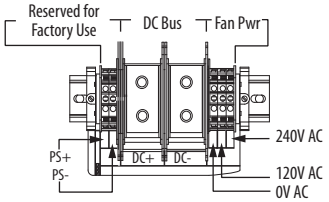
Power Terminal Block
2099-BM06-S, 2099-BM07-S, and 2099-BM08-S

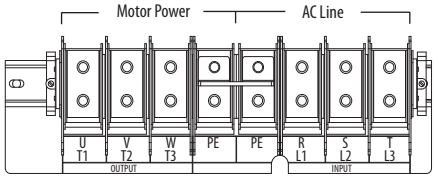


Power Terminal Block
2099-BM09-S

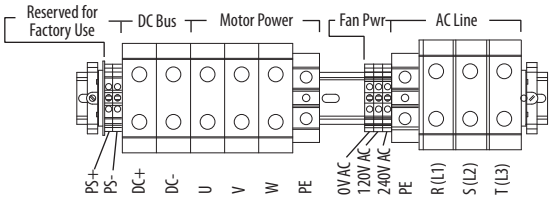


Power Terminal Block
2099-BM11-S and 2099-BM12-S





Power Terminal Block
2099-BM10-S



Kinetix 7000 System Power Component Compatibility Charts

These tables provide input power component combinations for Kinetix 7000 drives with compatible motors. Combinations are designed to provide optimum performance in common-bus configurations.

Input Power Components with HPK-B (460V) Motors

Kinetix 7000 Drive Cat. No.	Common Bus Accessories		Compatible Motors
	8720MC Regenerative Power Supply (1) 8720MC-RPS	**8720MC Line Reactor** (1)	
2099-BM07-S	8720MC-RPS065BM	8720MC-LR05-048B	HPK-B1307C
			HPK-B1308C
2099-BM08-S			HPK-B1307E
			HPK-B1310C
2099-BM09-S		8720MC-LR10-062B	HPK-B1308E
	8720MC-RPS065BM and 8720MC-RPS065BS	8720MC-LR05-048B (two units)	HPK-B1609E
			HPK-B1613C
2099-BM11-S		8720MC-LR10-062B (two units)	HPK-B1611E
			HPK-B1815C
	8720MC-RPS190BM	8720MC-LR10-100B (two units)	HPK-B1613E
			HPK-B2010C
			HPK-B2010E
			HPK-B2212C
2099-BM12-S			HPK-B2010E
			HPK-B2212C
			HPK-B2510C

(1) Regenerative Power Supply (RPS) selection is for this single motor/drive combination. When combining multiple drives on the same RPS module, the selection will change.

Input Power Components with HPK-E (400V) Motors

Kinetix 7000 Drive Cat. No.	Common Bus Accessories		Compatible Motors
	8720MC Regenerative Power Supply (1)	**8720MC Line Reactor** (1) 8720MC-LR*xx-xxx*B	
2099-BM08-S	8720MC-RPS065BM	8720MC-LR05-048B	HPK-E1307C
2099-BM09-S		8720MC-LR14-070B	HPK-E1308E
		8720MC-LR10-062B	HPK-E1310C
2099-BM11-S	8720MC-RPS065BM and 8720MC-RPS065BS	8720MC-LR05-048B (two units)	HPK-E1613C
		8720MC-LR10-062B (two units)	HPK-E1609E
			HPK-E1611E
			HPK-E1815C
	8720MC-RPS190BM	8720MC-LR10-100B (two units)	HPK-E1613E
			HPK-E2010C

(1) Regenerative Power Supply (RPS) selection is for this single motor/drive combination. When combining multiple drives on the same RPS module, the selection will change.

Input Power Components with MPL-B (460V) Motors

Kinetix 7000 Drive Cat. No.	Common Bus Accessories		Compatible Motors
	8720MC Regenerative Power Supply (1)	8720MC Line Reactor (1)	
2099-BM06-S	8720MC-RPS065BM	8720MC-LR05-048B	MPL-B540K
			MPL-B560F
			MPL-B580F
			MPL-B580J
			MPL-B640F
			MPL-B660F
			MPL-B680D
			MPL-B680F
			MPL-B860D
			MPL-B960B
			MPL-B980B
2099-BM07-S			MPL-B880C
		8720MC-LR10-062B	MPL-B880D
2099-BM08-S			MPL-B960C
			MPL-B960D
			MPL-B980C
			MPL-B980D

(1) Regenerative Power Supply (RPS) selection is for this single motor/drive combination. When combining multiple drives on the same RPS module, the selection will change.

Input Power Components with MPM-B (480V) Motors

Kinetix 7000 Drive Cat. No.	Common Bus Accessories		Compatible Motors
	8720MC Regenerative Power Supply (1)	8720MC Line Reactor (1)	
2099-BM06-S	8720MC-RPS065BM	8720MC-LR05-048B	MPM-B1651M
2099-BM06-S			MPM-B1652E
2099-BM06-S			MPM-B1652F
2099-BM06-S			MPM-B1653C
2099-BM06-S			MPM-B1653E
2099-BM06-S			MPM-B1653F
2099-BM06-S			MPM-B2152C
2099-BM07-S			MPM-B2152F
2099-BM06-S			MPM-B2152M
2099-BM06-S			MPM-B2153B
2099-BM07-S			MPM-B2153E
2099-BM07-S			MPM-B2153F
2099-BM07-S			MPM-B2154B
2099-BM07-S			MPM-B2154E
2099-BM06-S			MPM-B2154F

(1) Regenerative Power Supply (RPS) selection is for this single motor/drive combination. When combining multiple drives on the same RPS module, the selection will change.

Input Power Components with RDB-B (480V) Motors

Kinetix 7000 Drive Cat. No.	Common Bus Accessories		Compatible Motors
	8720MC Regenerative Power Supply (1)	8720MC Line Reactor (1)	
2099-BM06-S	8720MC-RPS065BM	8720MC-LR05-048B	RDB-B2152C
2099-BM06-S			RDB-B2153C
2099-BM07-S			RDB-B29029
2099-BM06-S			RDB-B29036
2099-BM08-S			RDB-B29039
2099-BM06-S			RDB-B41016
2099-BM08-S			RDB-B41018
2099-BM06-S			RDB-B41024
2099-BM09-S			RDB-B41026
2099-BM09-S			RDB-B41035

(1) Regenerative Power Supply (RPS) selection is for this single motor/drive combination. When combining multiple drives on the same RPS module, the selection will change.

Technical Specifications - Kinetix 7000 High Power Servo Drives

Kinetix 7000 Drive Power Specifications

Attribute	2099-BM06-S	2099-BM07-S	2099-BM08-S	2099-BM09-S	2099-BM10-S	2099-BM11-S	2099-BM12-S
AC input voltage	342…528V AC rms three-phase (380…480V nom)						
AC input frequency	47…63 Hz						
Bandwidth [1]							
Velocity loop	500 Hz						500 Hz
Current loop	1300 Hz						500 Hz
PWM frequency	4 kHz						2 kHz
Main AC input current							
Nom (rms)	36.7 A	47.7 A	59.6 A	90.1 A	117 A	169 A	233 A
Max inrush (A peak)	18.0 A	18.0 A	18.0 A	96.0 A	118 A	141 A	141 A
DC input voltage	450…750V DC						
DC input current	42.9 A	55.7 A	69.7 A	105 A	137 A	204 A	281 A
Control power input Voltage	18…30V DC (24V DC, nom)						
Control power DC input current							
Nom (rms)	3.3 A						
Maximum inrush (rms)	6.0 A						
Continuous output current (rms)	40.0 A	52.0 A	65.0 A	96.0 A	125 A	180 A	248 A
Continuous output current (0-pk)	56.0 A	73.0 A	92.0 A	135 A	176 A	254 A	351 A
Peak output current (rms)							
3 s duration	68.0 A	80.0 A	104 A	154 A	163 A	312 A	372 A
60 s duration	51.0 A	60.0 A	78.0A	115 A	138 A	234 A	273 A
Peak output current (0-pk)							
3 s duration	96.0 A	113 A	147 A	217.7 A	230.5 A	441 A	526 A
60 s duration	72.0 A	84.8 A	110 A	162.6 A	195 A	331 A	386 A
Bus overvoltage	800V DC						
Bus undervoltage	275…560V DC [2]						
Continuous power output, nom	22 kW	30 kW	37 kW	56 kW	75 kW	112 kW	149 kW
Continuous power output (Hp)	30 Hp	40 Hp	50 Hp	75 Hp	100 Hp	150 Hp	200 Hp
Maximum power cycles/minute							
AC line	4 per minute (pre-charge provided by drive)						
DC bus	2 per minute (DC pre-charge provided by the regenerative power supply)						
DC bus discharge time	3 minutes after removal of main AC power						
Efficiency	97.5%						
Total capacitance [3]	1800 µF	2400 µF	3000 µF	4500 µF	6000 µF	8400 µF	8400 µF
Short circuit current rating	200,000 A (rms) symmetrical						

(1) Bandwidth values vary based on tuning parameters and mechanical components.

(2) Bus undervoltage will vary based on input line voltage.

(3) If DC input is supplied to 2099-BM09-S, 2099-BM10-S, or 2099-BM11-S drives, the precharge capability must be provided at the system level. Disconnect switches must not be used between the input of the drive and a common DC bus without the use of an external precharge device.

Circuit Breaker/Fuse Specifications

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses. Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. Evaluation of the short-circuit available current is critical and must be kept below the short-circuit current rating of the circuit breaker.

Use class CC, T, RK1, or J fuses, with current rating as indicated in the table below. The following fuse examples and short-circuit current ratings are recommended for use with the 2099-BM*xx*-S drives when the Line Interface Module (LIM) is not used.

IMPORTANT LIM modules (catalog numbers 2094-BL*xx*S and 2094-XL75S-C*x*) provide branch circuit protection to the Kinetix 7000 drive. Follow all applicable NEC and local codes.

Fuse Specifications (AC input)

Drive Cat. No.	Bussmann Fuse	Dual Element Time Delay Fuse (min/max) A rms	Non-Time Delay Fuse (min/max) A rms	Motor Circuit Protector (max) A rms
2099-BM06-S	LPJ-90SP	50/90	50/150	50
2099-BM07-S	LPJ-110SP	60/110	60/200	70
2099-BM08-S	LPJ-125SP	80/125	80/250	100
2099-BM09-S	LPJ-200SP	125/200	125/300	125
2099-BM10-S	LPJ-250SP	150/250	150/500	150
2099-BM11-S	LPJ-400SP	225/400	225/600	250
2099-BM12-S	LPJ-500SP	300/550	300/700	400

Fuse Specifications (DC common bus)

Drive Cat. No.	Bussmann Fuse	Ferraz Shaumut Fuse
2099-BM06-S	FWJ-80A	HSJ80
2099-BM07-S	FWJ-100A	HSJ90
2099-BM08-S	FWJ-125A	HSJ100
2099-BM09-S	FWJ-175A	HSJ175
2099-BM10-S	FWJ-200A	HSJ200
2099-BM11-S	FWJ-500A	HSJ400
2099-BM12-S	FWJ-500A	HSJ400

Weight Specifications

Drive Cat. No.	Weight, approx kg (lb)
2099-BM06-S	18.55 (40.9)
2099-BM07-S	
2099-BM08-S	

Drive Cat. No.	Weight, approx kg (lb)
2099-BM09-S	37.2 (82.0)
2099-BM10-S	
2099-BM11-S	71.4 (157.5)
2099-BM12-S	

Contactor Ratings

The table below lists the recommended contactor ratings for Kinetix 7000 drives installed without a Line Interface Module.

Drive Cat. No.	Contactor	Safety Contactor	Coil Type	Coil Voltage Requirements
2099-BM06-S	100-C43DJ01	100S-C43-DJD4C	Standard with Diode	24V DC
2099-BM07-S	100-D95EN11	100S-D95EN22C	Electronic Coil (1)	24V DC for control and 480V AC for coil power
2099-BM08-S				
2099-BM09-S				
2099-BM10-S	100-D140EN11	100S-D140EN22C		
2099-BM11-S	100-D180EN11	100S-D180EN22C		
2099-BM12-S	100-D250EN11	100S-D250EN22C		

(1) Electronic coil control power requirements = 24V DC @ 15 mA.

Power Dissipation Specifications

Use this table to size an enclosure and calculate required ventilation for your Kinetix 7000 drive system.

Drive Cat. No.	Usage as % of Rated Power Output W	
	50%	100%
2099-BM06-S	294	465
2099-BM07-S	388	619
2099-BM08-S	452	730

Drive Cat. No.	Usage as % of Rated Power Output W	
	50%	100%
2099-BM09-S	645	1072
2099-BM10-S	882	1479
2099-BM11-S	1275	2125
2099-BM12-S	1438	2437

Maximum Feedback Cable Lengths

Although motor power and feedback cables are available in standard lengths up to 90 m (295.3 ft), the drive/motor/feedback combination may limit the maximum feedback cable length. This table assumes the use of recommended cables as shown in the Kinetix Motion Accessories Technical Data, publication GMC-TD004.

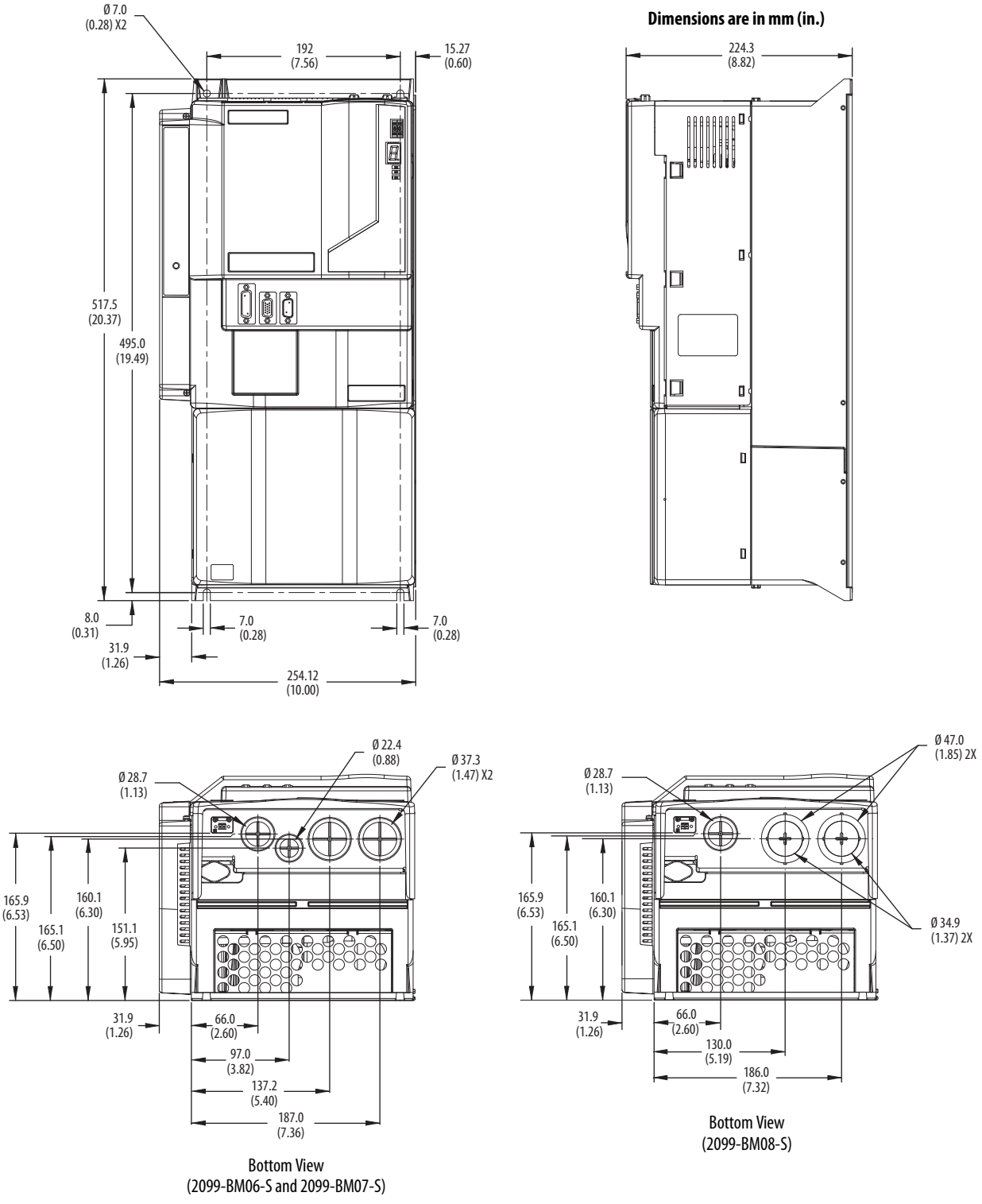
Cable Lengths for Compatible Rotary Motors

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)
MPL-B5*xxx*… MPL-B9*xxx*-S/M		90 (295.3)
MPM-B165*xx*… MPM-B215*xx*-S/M		90 (295.3)
RDB-B215*xx*-7/3	30 (98.4)	
RDB-B290*xx*-7/3 or RDB-B410*xx*-7/3	90 (295.3)	
HPK-B*xxxxx*-S/M or HPK-E*xxxxx*-S/M		90 (295.3)

Dimensions - Kinetix 7000 High Power Servo Drives

2099-BM06-S, 2099-BM07-S, and 2099-BM08-S Dimensions

Dimensions are in mm (in.)

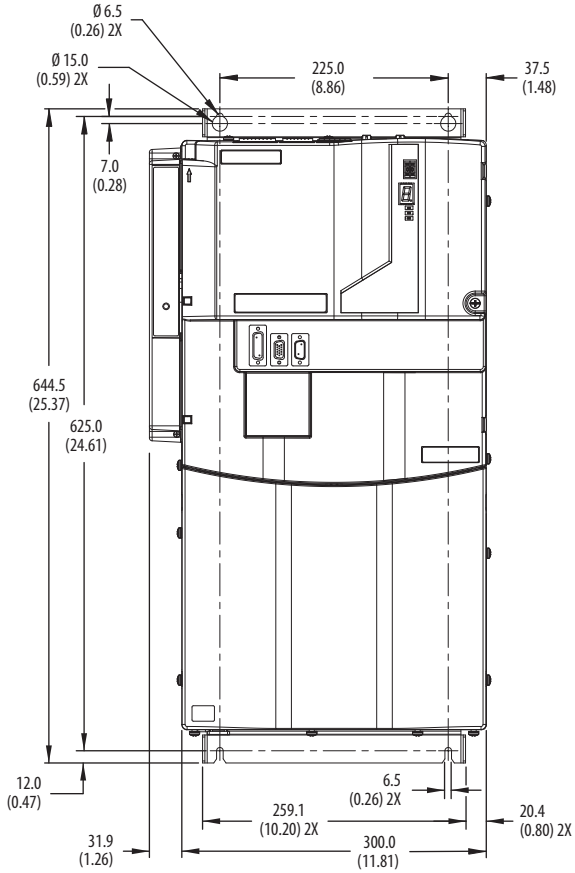


Bottom View
(2099-BM06-S and 2099-BM07-S)

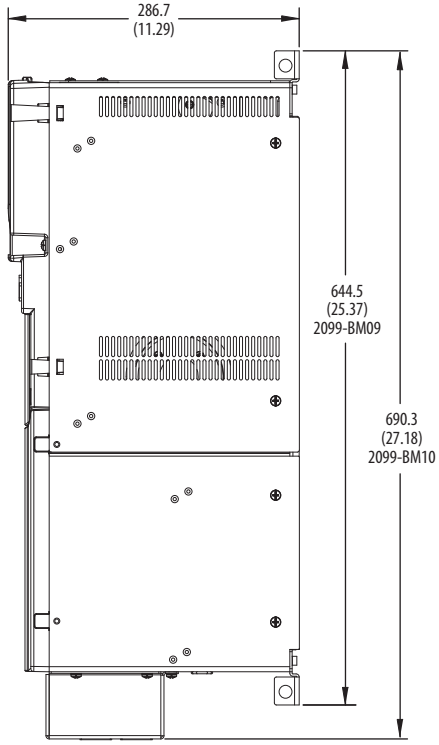
Bottom View
(2099-BM08-S)

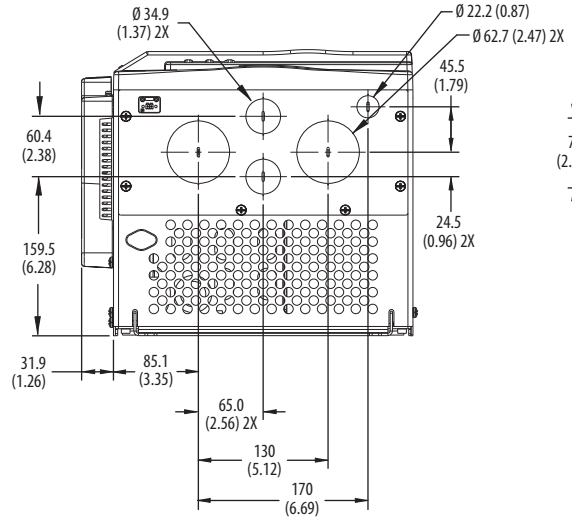
2099-BM09-S and 2099-BM10-S Dimensions

Dimensions are in mm (in.)

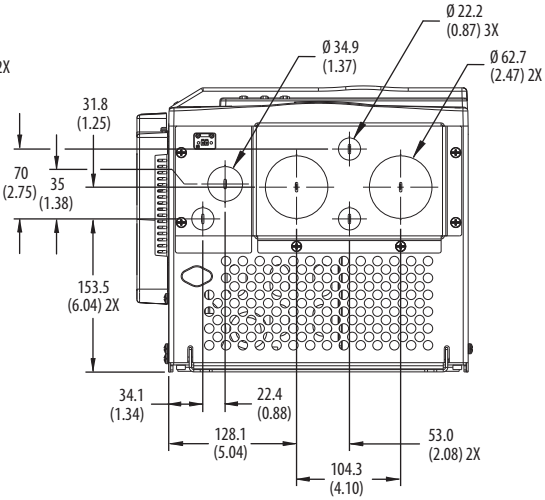


Some Components are Removed for Clarity





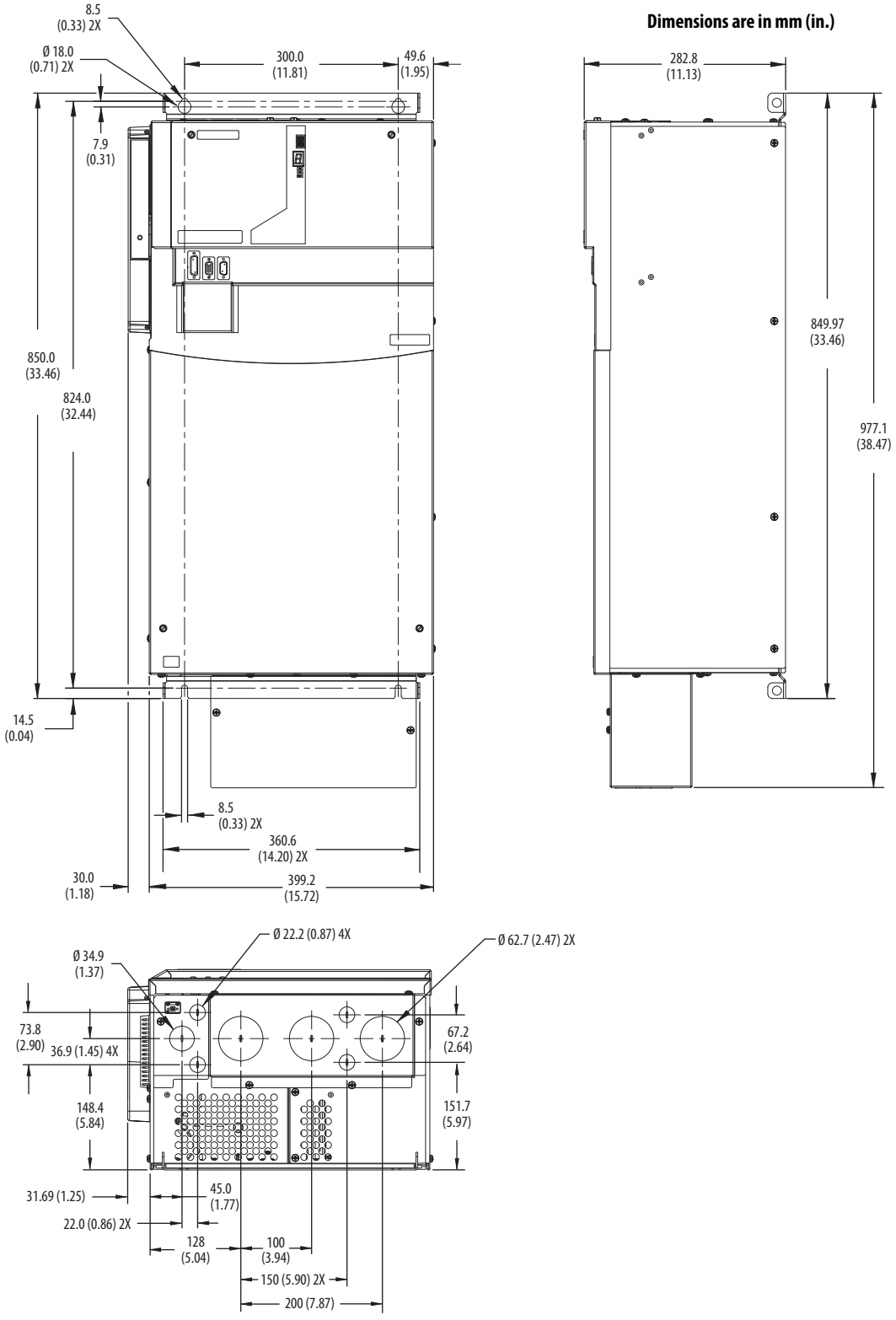
Bottom View
(2099-BM09-S)



Bottom View
(2099-BM10-S)

2099-BM11-S and 2099-BM12-S Dimensions

Dimensions are in mm (in.)



Environmental Specifications - Kinetix 7000 High Power Servo Drives

Attribute	Operational Range	Storage Range (nonoperating)
Temperature, ambient	0…50 °C (32…122 °F)	-40…70 °C (-40…158 °F)
Relative humidity	5…95% noncondensing	5…95% noncondensing
Altitude	1000 m (3281 ft) 3000 m (9843 ft) with derating	3000 m (9843 ft) during transport
Vibration	5…55 Hz @ 0.35 mm (0.014 in.) double amplitude, continuous displacement; 55…500 Hz @ 2.0 g peak constant acceleration (10 sweeps in each of 3 mutually perpendicular directions)	
Shock	15 g, 11 ms half-sine pulse (3 pulses in each direction of 3 mutually perpendicular directions)	

Certifications - Kinetix 7000 High Power Servo Drives

Agency Certification (1)	Standards
c-UL-us (2)	UL Listed to U.S. and Canadian safety standards (UL 508C File E59272).
	Solid-state motor overload protection provides dynamic fold-back of motor current when 110% of the motor rating is reached with a peak current limit based on the peak rating of the motor as investigated by UL to comply with UL 508C (UL File E59272, volume 1, section 22).
CE	European Union 2004/108/EC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC Product Standard including specific test methods.
	European Union 2006/95/EC Low Voltage Directive compliant with EN 50178:1997 - Electronic Equipment for use in Power Installations.
Functional Safety	• EN 60204-1:2006 - Safety of Machinery - Electrical Equipment of Machines. • IEC 61508: Part 1-7:2000 - Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems. • EN ISO 13849-1:2008 - Safety of machinery. Safety related parts of control systems. Part 1: General principles for design.
C-Tick	Australian Radio Communications Act, compliant with: • Radio Communications Act: 1992 • Radio Communications (Electromagnetic Compatibility) Standard: 1998 • Radio Communications (Compliance Labelling - Incidental Emissions) Notice: 1998 • AS/NZS CISPR 11: 2003 (Group 2, Class A)
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3 • Registration number: KCC-REM-RAA-2099

(1) When product is marked, refer to http://www.ab.com for Declarations of Conformity Certificates.
(2) Underwriters Laboratories Inc. has not evaluated the safe-off option in these products.

Accessories - Kinetix 7000 High Power Servo Drives

Cat. No.	Description
2099-K7KCB-1	Control board assembly kit. Replacement control board for 2099-BM*xx*-S drives.
2099-K7KCP-1	DC-DC converter cassette kit. Replacement DC-DC converter for 2099-BM*xx*-S drives.

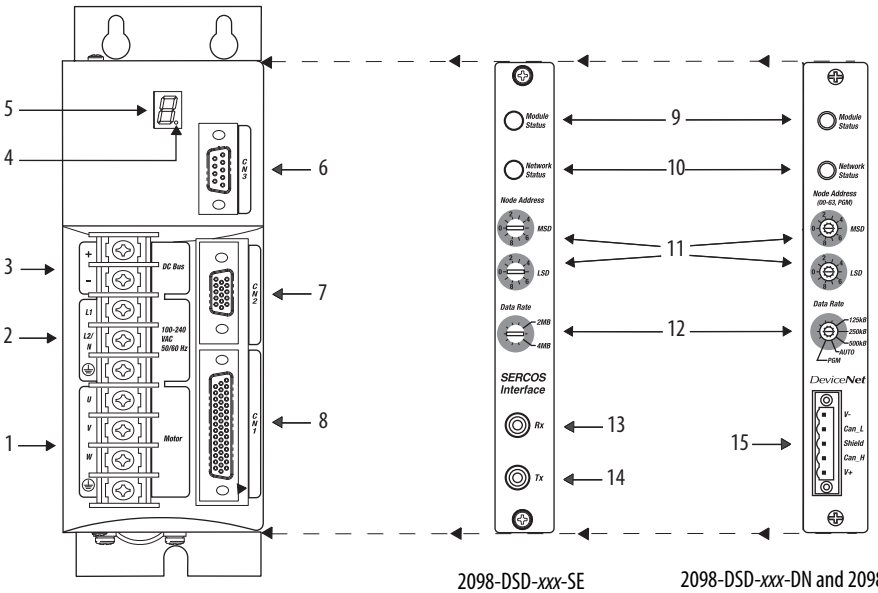
Ultra3000 Digital Servo Drives

The Ultra™ 3000, Ultra3000X, Ultra3000-SE, Ultra3000-DN, and Ultra3000X-DN drives make up a family of flexible, high-performance digital servo drives for a variety of motion control applications and architectures. The wide range of power platforms, connectivity options and functions make the Ultra3000 digital servo drive family an attractive solution for a variety of machine control architectures including Logix, SLC, and third-party machine and motion control systems. In addition, the Ultra3000X indexing, Ultra3000-SE, Ultra3000-DN, Ultra3000X-DN drives are positioning drives designed for applications requiring either simple or complex motion profiles.

The Ultra3000 servo drives (catalog numbers 2098-DSD-*xxx*-SE and 2098-DSD-HV*xxx*-SE) provide Integrated Motion capability through the sercos interface and are part of the Kinetix Integrated Motion solution.

Ultra3000 Servo Drive Features and Indicators

2098-DSD-005, 2098-DSD-010, 2098-DSD-020 Ultra3000 (200V-class) Drives



2098-DSD-*xxx* and 2098-DSD-*xxx*X
Ultra3000 and Ultra3000 Indexing Drives

2098-DSD-*xxx*-SE
Ultra3000 Sercos Interface Drives

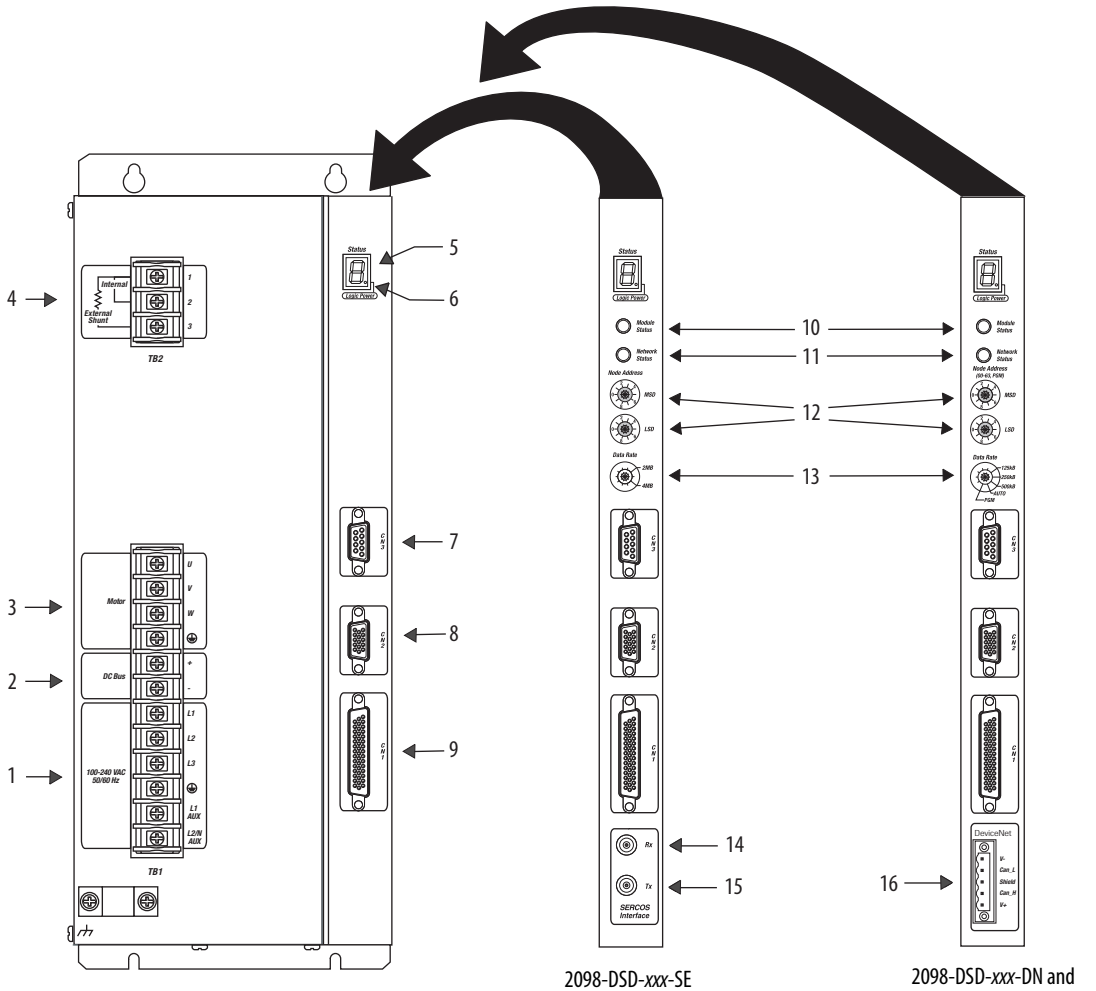
2098-DSD-*xxx*-DN and 2098-DSD-*xxx*X-DN
Ultra3000 DeviceNet and
DeviceNet Indexing Drives

Item	Description
1	Motor power connections
2	AC input power connections
3	DC bus connections for active shunt resistor kit
4	Logic power
5	Seven-segment fault status indicator

Item	Description
6	CN3 9-pin serial port connector
7	CN2 15-pin motor feedback connector
8	CN1 44-pin user I/O connector
9	Module status indicator
10	Network status indicator

Item	Description
11	Sercos node address switches
12	Data rate switch
13	Sercos receive (Rx) connector
14	Sercos transmit (Tx) connector
15	DeviceNet interface connector

2098-DSD-030, 2098-DSD-075, and 2098-DSD-150 Ultra3000 (200V-class) Drives



2098-DSD-*xxx* and 2098-DSD-*xxx*X
Ultra3000 and Ultra3000 Indexing Drives

2098-DSD-*xxx*-SE
Ultra3000 Sercos Interface Drives

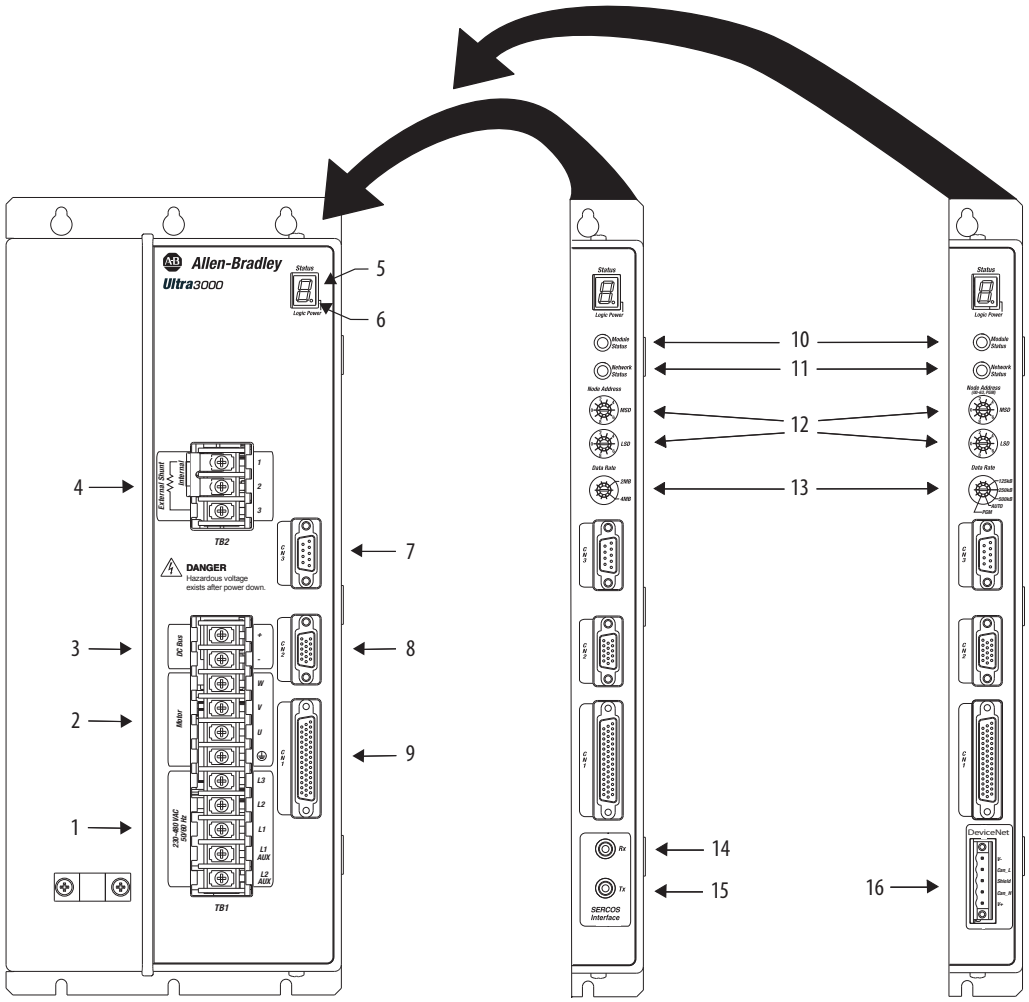
2098-DSD-*xxx*-DN and
2098-DSD-*xxx*X-DN
Ultra3000 DeviceNet and
DeviceNet Indexing Drives

Item	Description
1	AC input power connections (1)
2	DC bus connections for active shunt resistor kit
3	Motor power connections
4	Passive shunt resistor connections
5	Seven-segment fault status indicator
6	Logic power
7	CN3 9-pin serial port connector
8	CN2 15-pin motor feedback connector

Item	Description
9	CN1 44-pin user I/O connector
10	Module status indicator
11	Network status indicator
12	Sercos node address switches
13	Data rate switch
14	Sercos receive (Rx) connector
15	Sercos transmit (Tx) connector
16	DeviceNet interface connector

(1) The 2098-DSD-030*x-xx* drives do not have an L3 power terminal.

2098-DSD-HV030, 2098-DSD-HV050, 2098-DSD-HV100, 2098-DSD-HV150, and 2098-DSD-HV220 Ultra3000 (400V-class) Drives



2098-DSD-HV*xxx* and 2098-DSD-HV*xxx*X
Ultra3000 and Ultra3000 Indexing Drives

2098-DSD-HV*xxx*-SE
Ultra3000 Sercos Interface Drives

2098-DSD-HV*xxx*-DN and
2098-DSD-HV*xxx*X-DN
Ultra3000 DeviceNet and
DeviceNet Indexing Drives

Item	Description
1	AC input power connections
2	DC bus connections for active shunt resistor kit
3	Motor power connections
4	Passive shunt resistor connections
5	Seven-segment fault status indicator
6	Logic power
7	CN3 9-pin serial port connector
8	CN2 15-pin motor feedback connector

Item	Description
9	CN1 44-pin user I/O connector
10	Module status indicator
11	Network status indicator
12	Sercos node address switches
13	Data rate switch
14	Sercos receive (Rx) connector
15	Sercos transmit (Tx) connector
16	DeviceNet interface connector

Ultra3000 Servo Drive Communication Interface

Drive Type	Drive Cat. No.	Command Interface
Sercos interface drive	2098-DSD-*xxx*-SE and 2098-DSD-HV*xxx*-SE	Fiber-optic sercos ring
Analog drive	2098-DSD-*xxx* and 2098-DSD-HV*xxx*	Analog command interface
Digital drive with DeviceNet interface	2098-DSD-*xxx*-DN and 2098-DSD-HV*xxx*-DN	DeviceNet communication interface
Indexing drive	2098-DSD-*xxx*X and 2098-DSD-HV*xxx*X	Standalone control
Indexing DeviceNet interface drives	2098-DSD-*xxx*X-DN and 2098-DSD-HV*xxx*X-DN	

Technical Specifications - Ultra3000 Digital Servo Drives

Specifications apply to these Ultra3000 drive models:

- SE indicates the 2098-DSD-*xxx*-SE sercos interface drive
- DN indicates the 2098-DSD-*xxx*-DN DeviceNet interface drive
- X indicates the 2098-DSD-*xxx*X indexing drive
- X-DN indicates the 2098-DSD-*xxx*X-DN indexing DeviceNet interface drive

Ultra3000 (200V-class) Drives Power Specifications

Attribute	2098-DSD-005	2098-DSD-010	2098-DSD-020
AC input voltage (1)	100…240V rms, single-phase		
AC input frequency	47…63 Hz		
AC input current (2) (3) Nom (rms) 230V AC (0-pk) max inrush (4)	 5 A 100 A - Series A or B 20 A - Series C	 9 A 100 A - Series A or B 20 A - Series C	 18 A 100 A - Series A or B 20 A - Series C
Continuous output current (rms)	1.8 A	3.5 A	7.1 A
Continuous output current (0-pk)	2.5 A	5.0 A	10 A
Peak output current (rms)	5.3 A	10.6 A	21.2 A
Peak output current (0-pk)	7.5 A	15 A	30 A
Bus capacitance	1410 µF	1880 µF	1880 µF
Internal shunt resistance	N/A	N/A	N/A
Shunt on	N/A	N/A	N/A
Shunt off	N/A	N/A	N/A
Bus overvoltage	400V DC	400V DC	400V DC
Energy absorption capability 115V AC input 230V AC input	 93 J 38 J	 125 J 51 J	
Continuous power output 115V AC input 230V AC input	 0.25 kW 0.5 kW	 0.5 kW 1.0 kW	 1.0 kW 2.0 kW

(1) Specification is for nominal voltage. The absolute limits are ±10%, or 88…265V rms.

(2) The 2098-DSD-005*x-xx,* 2098-DSD-010*x-xx,* and 2098-DSD-020*x-xx* (200V-class) drives are limited to:
Series A or B - one contactor cycle every two minutes.
Series C - one contactor cycle every 10 s for up to two minutes, not to exceed 12 cycles in five minutes.

(3) Power initialization requires a short period of inrush current. Dual element time delay (slow blow) fuses are recommended (refer to Fuse Specifications on page 91).

(4) In-rush current limiting circuitry is enabled within 3 s after removal of AC line power.

Ultra3000 (200V-class) Drives Power Specifications

Attribute	2098-DSD-030	2098-DSD-075	2098-DSD-150
AC input voltage [1]	100…240V rms, single-phase	100…240V rms, three-phase	
AC input frequency	47…63 Hz		
Main AC input current [2] [3]			
Nom (rms)	28 A	30 A	46 A
230V AC (0-pk) max inrush	50 A	50 A	68 A
Auxiliary AC input current			
115V AC (rms) nom	1.0 A	1.0 A	1.0 A
230V AC (rms) nom	0.5 A	0.5 A	0.5 A
115V AC (0-pk) max inrush [4]	47 A	47 A	47 A
230V AC (0-pk) max inrush [4]	95 A	95 A	95 A
Continuous output current (rms)	10.6 A	24.7 A	45.9 A
Continuous output current (0-pk)	15 A	35 A	65 A
Peak output current (rms)	21.2 A	53 A	106 A
Peak output current (0-pk)	30 A	75 A	150 A
Bus capacitance	2820 µF	4290 µF	7520 µF
Internal shunt resistance	35 Ω	16.5 Ω	9.1 Ω
Shunt on	420V DC	420V DC	420V DC
Shunt off	402V DC	402V DC	402V DC
Bus overvoltage	452V DC	452V DC	452V DC
Internal shunt			
Continuous power	50 W	50 W	180 W
Peak power	4.5 kW	10 kW	18 kW
External shunt			
Resistance	30 Ω (-0/+5%)	16.5 Ω (-0/+5%)	9 Ω (-0/+5%)
Continuous power	2.4 kW	4 kW	8 kW
Peak power	6 kW	10 kW	19 kW
Energy absorption capability			
115V AC input	251 J	381 J	669 J
230V AC input	139 J	211 J	370 J
Continuous power output			
115V AC input	1.5 kW	N/A	N/A
230V AC input	3 kW	7.5 kW	15 kW

(1) Specification is for nominal voltage. The absolute limits are ±10%, or 88…265V rms.

(2) The 2098-DSD-030*x-xx*, 2098-DSD-075*x-xx*, and 2098-DSD-150*x-xx* (200V-class) drives are limited to one contactor cycles per two minutes.

(3) Power initialization requires a short period of inrush current. Dual element time delay (slow blow) fuses are recommended (refer to Fuse Specifications on page 91).

(4) 400 µs half wave sine.

Ultra3000 (400V-class) Drives Power Specifications

Attribute	2098-DSD-HV030	2098-DSD-HV050	2098-DSD-HV100	2098-DSD-HV150	2098-DSD-HV220
AC input voltage [1] [2]	230…480V rms, three-phase				
AC input Frequency	47…63 Hz				
Main AC input current [3] [4]					
460V AC (rms) nom	4 A	7 A	14 A	20 A	28 A
460V AC (rms) max inrush	6 A	6 A	6 A	6 A	6 A
Auxiliary AC input current					
230V AC (rms) nom	0.55 A				
360V AC (rms) nom	0.35 A				
480V AC (rms) nom	0.25 A				
230V AC (0-pk) max inrush [5]	47 A				
480V AC (0-pk) max inrush [5]	68 A				
Continuous output current (rms)	5.0 A	7.8 A	16.3 A	24.0 A	33.2 A
Continuous output current (0-pk)	7.0 A	11 A	23 A	34 A	47 A
Peak output current (rms)	9.9 A	15.6 A	32.5 A	48.1 A	66.5 A
Peak output current (0-pk)	14 A	22 A	46 A	68 A	94 A
Bus capacitance	470 µF		705 µF	940 µF	1880 µF
Internal shunt resistance	120 Ω		40 Ω	25 Ω	20 Ω
Shunt on					
230V AC input	400V DC				
480V AC input	800V DC				
Shunt off					
230V AC input	375V DC				
480V AC input	750V DC				
Bus overvoltage					
230V AC input	410V DC				
480V AC input	810V DC				
Internal shunt					
Continuous power	100 W		200 W	200 W	400 W
Peak power	5.3 kW		16 kW	25.6 kW	32 kW
External shunt					
Resistance (-0/+5%)	120 Ω		40 Ω	25 Ω	20 Ω
Continuous power	3 kW		10 kW	15 kW	22 kW
Peak power	5.3 kW		16 kW	25.6 kW	32 kW
Energy absorption capability					
230V AC input with 230V motor	15 J		22 J	29 J	59 J
230V AC input with 460V motor	129 J		194 J	259 J	517 J
480V AC input	55 J		82 J	109 J	219 J
Continuous power output					
230V AC input	1.5 kW	2.5 kW	5.0 kW	7.5 kW	11 kW
480V AC input	3.0 kW	5.0 kW	10 kW	15 kW	22 kW

(1) Specification is for nominal voltage. The absolute limits are ±10%, or 207…264V rms and 324…528V rms.

(2) The 2098-DSD-HV*xxx-xx* drives can be powered with 230V rms and used with motors designed for 230V operation. In such cases, the voltage levels used for shunting and DC bus overvoltage limits are adjusted to be compatible with the voltage limit of the motor.
The 2098-DSD-HV*xxx-xx* drives can be powered with 480V rms and used with motors designed for 480V operation. In such cases, the voltage levels used for shunting and DC bus overvoltage limits are adjusted to be compatible with the voltage limit of the motor.

(3) The 2098-DSD-HV*xxx -xx* (400V-class) drives are limited to three contactor cycles per minute.

(4) Power initialization requires a short period of inrush current (processor controlled via soft start circuitry). Dual element time delay (slow blow) fuses are recommended.

(5) 400 µs half wave sine.

Fuse Specifications

Use class CC, G, J, L, R, or T fuses, with current ratings as indicated in the table below.

Fuse Examples for Ultra3000 Drives

Drive Cat. No.	Voltage Class	Input Type	Recommended Fuse	
			Class CC (1)	Class J (1)
2098-DSD-005	200V AC	Input power	FNQ-R-6	LPJ-6SP
2098-DSD-010			FNQ-R-10	LPJ-10SP
2098-DSD-020			FNQ-R-20	LPJ-20SP
2098-DSD-030			FNQ-R-30	LPJ-30SP
2098-DSD-075			FNQ-R-30	LPJ-30SP
2098-DSD-150			N/A	LPJ-60SP
2098-DSD-*xxx*		Auxiliary input power	FNQ-R-10	LPJ-10SP
2098-DSD-HV030	400V AC	Input power	KTK-R-5	LPJ-5SP
2098-DSD-HV050			KTK-R-8	LPJ-8SP
2098-DSD-HV100			KTK-R-20	LPJ-17-1/2SP
2098-DSD-HV150			KTK-R-30	LPJ-30SP
2098-DSD-HV220			N/A	LPJ-35SP
2098-DSD-HV*xxx*		Auxiliary input power	FNQ-R-10	LPJ-10SP

(1) Part numbers shown are examples of Bussmann fuses.

Circuit Breaker Specifications

While circuit breakers offer some convenience, there are limitations for their use. Circuit breakers do not handle high current inrush as well as fuses.

Make sure the selected components are properly coordinated and meet acceptable codes including any requirements for branch circuit protection. Evaluation of the short-circuit available current is critical and must be kept below the short-circuit current rating of the circuit breaker.

Circuit Breaker Examples for Ultra3000 (400V-class) Drives

Drive Cat. No.	Voltage Class	Circuit Breakers
2098-DSD-HV030	400V	140M-F8E-C16
2098-DSD-HV050		140M-F8E-C20
2098-DSD-HV100		140M-F8E-C32
2098-DSD-HV150		140M-F8E-C45
2098-DSD-HV220		N/A

Contactor Ratings

Drive Cat. No.	Voltage Class	Contactor
2098-DSD-HV030	400V	100-C23*x*10 (AC coil) 100-C23Z*x*10 (DC coil)
2098-DSD-HV050		100-C30*x*10 (AC coil) 100-C30Z*x*10 (DC coil)
2098-DSD-HV100		100-C37*x*10 (AC coil) 100-C37Z*x*10 (DC coil)
2098-DSD-HV150		100-C43*x*10 (AC coil) 100-C43Z*x*10 (DC coil)
2098-DSD-HV220		100-C60*x*10 (AC coil) 100-C60Z*x*10 (DC coil)

Power Dissipation Specifications

Drive Cat. No.	Loss, max W
2098-DSD-005	48
2098-DSD-010	48
2098-DSD-020	50
2098-DSD-030	150 + dissipative shunt
2098-DSD-075	300 + dissipative shunt
2098-DSD-150	500 + dissipative shunt

Drive Cat. No.	Loss, max W
2098-DSD-HV030	175 + dissipative shunt
2098-DSD-HV050	175 + dissipative shunt
2098-DSD-HV100	350 + dissipative shunt
2098-DSD-HV150	350 + dissipative shunt
2098-DSD-HV220	600 + dissipative shunt

Weight Specifications

Drive Cat. No.	Weight, approx kg (lb)	
2098-DSD-005	1.80 kg	(4.1 lb)
2098-DSD-010	2.10 kg	(4.6 lb)
2098-DSD-020	2.10 kg	(4.6 lb)
2098-DSD-030	6.20 kg	(13.6 lb)
2098-DSD-075	9.30 kg	(20.6 lb)
2098-DSD-150	14.1 kg	(31.0 lb)

Drive Cat. No.	Weight, approx kg (lb)	
2098-DSD-HV030	8.55 kg	(18.8 lb)
2098-DSD-HV050	8.55 kg	(18.8 lb)
2098-DSD-HV100	10.44 kg	(22.9 lb)
2098-DSD-HV150	10.44 kg	(22.9 lb)
2098-DSD-HV220	14.1 kg	(31.0 lb)

Communication Specifications

Attribute	Value
Sercos (option)	
Communication rates	4 and 8 Mbps
Node addresses	01…99
DeviceNet (option)	
Power consumption from network	60 mA
Data rates	125, 250, and 500 kps, and auto-baud
Node addresses	00…63
Messaging capabilities	Explicit, polled I/O, change of state, and cyclic messaging
Serial	
Ports	One RS-232/RS-422/RS-485
Communication rates	1200, 2400, 4800, 9600, 19,200, and 38,400 bps

Inputs/Outputs Specifications

Attribute	Value
Digital inputs	8 optically isolated, 12…24V, active high, current sinking
Digital outputs	4 optically isolated, 12…24V, active high, current sourcing
Relay output	One normally open relay, 30V DC, max, 1 A, max
I/O response	100 µs
Digital I/O firmware scan period	1 ms
Analog inputs COMMAND ILIMIT	 14-bit A/D, ±10V 10-bit A/D, 0 to 10V
Analog output	±10V, 8 bits, 2 mA max

Auxiliary Feedback Specifications

Attribute	Value
Input modes	A quad B, Step/Direction, CW/CCW
Maximum input frequency	2.5 MHz
Input types	Differential, single-ended, open collector (1)

(1) Differential input types are recommended.

Connector Specifications

Connector	Description	Specification
CN1	User input/output	44-pin high-density female D-sub connector
CN2	Motor feedback connector	15-pin high-density female D-sub connector
CN3	Serial port connector	9-pin female D-sub connector
TB1 and TB2	Main and auxiliary AC, DC bus, motor power, and shunt connectors	Screw terminal block

Maximum Feedback Cable Lengths

Although motor feedback cables are available in standard lengths up to 90 m (295.3 ft), the drive/motor/feedback combination may limit the maximum cable length, as shown in the tables below. These tables assume the use of recommended cables as shown in the Kinetix Motion Accessories Technical Data, publication GMC-TD004.

Maximum Cable Lengths for Compatible Rotary Motors

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)
MPL-A15*xxx*...MPL-A2*xxx*-E/V	90 (295.3)		
MPL-A3*xxx*...MPL-A5*xxx*-S/M (1)	90 (295.3)		
MPL-B15*xxx*...MPL-B2*xxx*-E/V		90 (295.3)	
MPL-B3*xxx*...MPL-B9*xxx*-S/M		90 (295.3)	
MPL-A/B15*xxx*...MPL-A/B45*xxx*-H			45 (147.6)
MPM-A*xxxxx*-S/M	30 (98.4)		
MPM-B*xxxxx*-S/M		90 (295.3)	
MPF-A*xxxx*-S/M (1)	90 (295.3)		
MPF-B*xxxx*-S/M		90 (295.3)	
MPS-A*xxxx*-S/M	90 (295.3)		
MPS-B*xxxx*-S/M		90 (295.3)	
TLY-A*xxxx*-H			30 (98.4)

(1) MPL-A5*xxx* and MPF-A5*xxx* motor encoders are rated for 9V, the remaining Bulletin MPL and MPF (200V-class) motor encoders are rated for 5V.

Maximum Cable Lengths for Compatible Linear Actuators

Actuator Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Absolute High-resolution (9V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)
MPMA-A*xxxxx* or MPAS-A*xxxxx*-V (ballscrew)	90 (295.3)		
MPMA-A*xxxxx* or MPAS-A*xxxxx*-A (direct drive)			45 (147.6)
MPMA-B*xxxxx* or MPAS-B*xxxxx*-V (ballscrew)		90 (295.3)	
MPMA-B*xxxxx* or MPAS-B*xxxxx*-A (direct drive)			45 (147.6)
MPAR-A*xxxxx*-V/M	30 (98.4)		
MPAR-B*xxxxx*-V/M		90 (295.3)	
MPAI-A*xxxxx*M3	30 (98.4)		
MPAI-B*xxxxx*M3		90 (295.3)	

Maximum Cable Lengths for Compatible Linear Motors

Motor Cat. No.	Absolute High-resolution (5V) Encoder m (ft)	Incremental/TTL (5V) Encoder m (ft)
LDC-Series or LDL-Series	30 (98.4)	30 (98.4)

Environmental Specifications - Ultra3000 Digital Servo Drives

Attribute	Value
Temperature, ambient Operating Storage	 0…55 °C (32…131 °F) -40…70 °C (-40…158 °F)
Relative humidity	5…95% noncondensing
Altitude	1500 m (4921.5 ft) - Derate 3% per 300 m (984.3 ft) above 1500 m (4921.5 ft)
Vibration	5…2000 Hz @ 2.5 g peak, 0.0006 mm (0.015 in.) max displacement
Shock	15 g, 11 ms half-sine

Certifications - Ultra3000 Digital Servo Drives

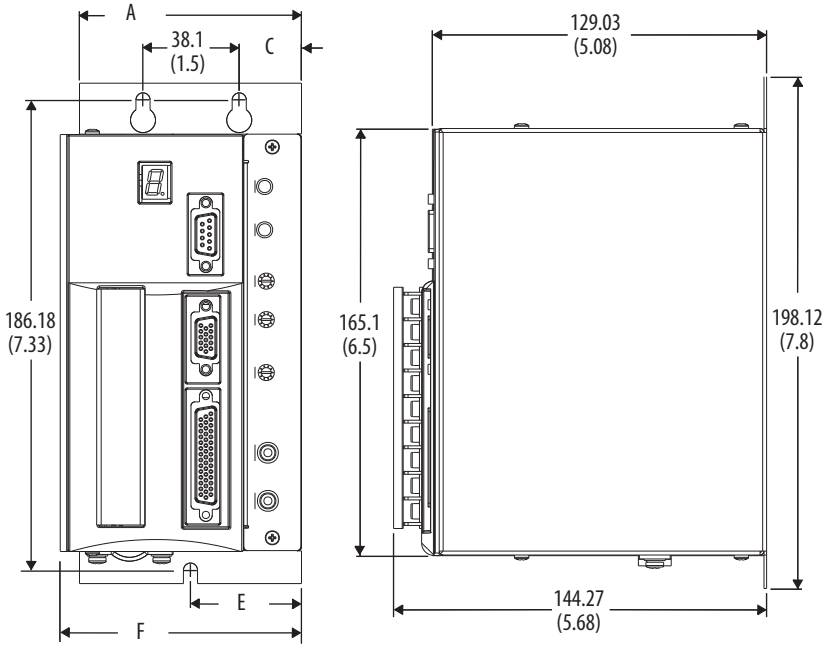
Agency Certification (1)	Standards
c-UL-us	UL Listed to U.S. and Canadian safety standards (UL 508C File E59272).
	Solid-state motor overload protection provides dynamic fold-back of motor current when 110% of the motor rating is reached with a peak current limit based on the peak rating of the motor as investigated by UL to comply with UL 508C (UL File E59272, volume 1, section 22).
CE	European Union 2004/108/EC EMC Directive compliant with EN 61800-3:2004: Adjustable Speed Electrical Power Drive Systems - Part 3; EMC Product Standard including specific test methods.
	European Union 2006/95/EC Low Voltage Directive compliant with EN 50178:1997 - Electronic Equipment for use in Power Installations.
KC	Korean Registration of Broadcasting and Communications Equipment, compliant with: • Article 58-2 of Radio Waves Act, Clause 3 • Registration number: KCC-REM-RAA-2098-DSD

(1) When product is marked, refer to http://www.ab.com for Declarations of Conformity Certificates.

Dimensions - Ultra3000 Digital Servo Drives

In this figure, *-xxx* is replaced by -005, -010, or -020 to represent the Ultra3000 500 W, 1 kW, and 2 kW drives respectively.

2098-DSD-*xxx*, 2098-DSD-*xxx*X, 2098-DSD-*xxx*-SE, 2098-DSD-*xxx*-DN, 2098-DSD-*xxx*X-DN Dimensions



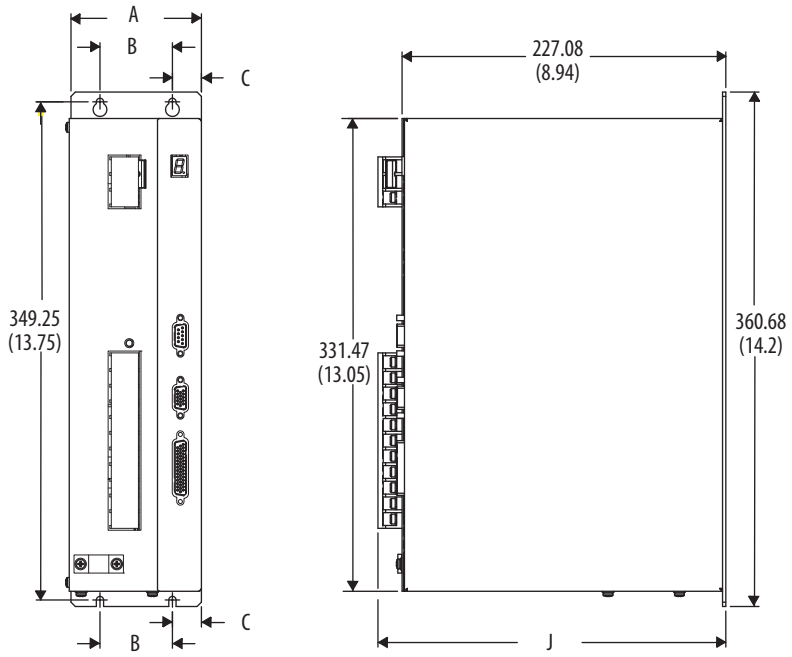
Dimensions are in mm (in.)

Unit shown is the 2098-DSD-005-SE.

Ultra3000 Drive Cat. No.	A mm (in.)	C mm (in.)	E mm (in.)	F mm (in.)
2098-DSD-005, 2098-DSD-005X	65.02 (2.56)	13.26 (0.52)	32.77 (1.29)	72.64 (2.86)
2098-DSD-010, 2098-DSD-010X, 2098-DSD-020, 2098-DSD-020X				98.1 (3.89)
2098-DSD-005-SE, 2098-DSD-005-DN, 2098-DSD-005X-DN	87.88 (3.46)	24.64 (0.97)	43.94 (1.73)	95.5 (3.76)
2098-DSD-010-SE, 2098-DSD-010-DN, 2098-DSD-010X-DN, 2098-DSD-020-SE, 2098-DSD-020-DN, 2098-DSD-020X-DN				121.54 (4.79)

In this figure, *-xxx* is replaced by -030, -075, or -150 to represent the Ultra3000 3, 7.5, and 15 kW drives respectively.

2098-DSD-*xxx*, 2098-DSD-*xxx*X, 2098-DSD-*xxx*-SE, 2098-DSD-*xxx*-DN, 2098-DSD-*xxx*X-DN Dimensions



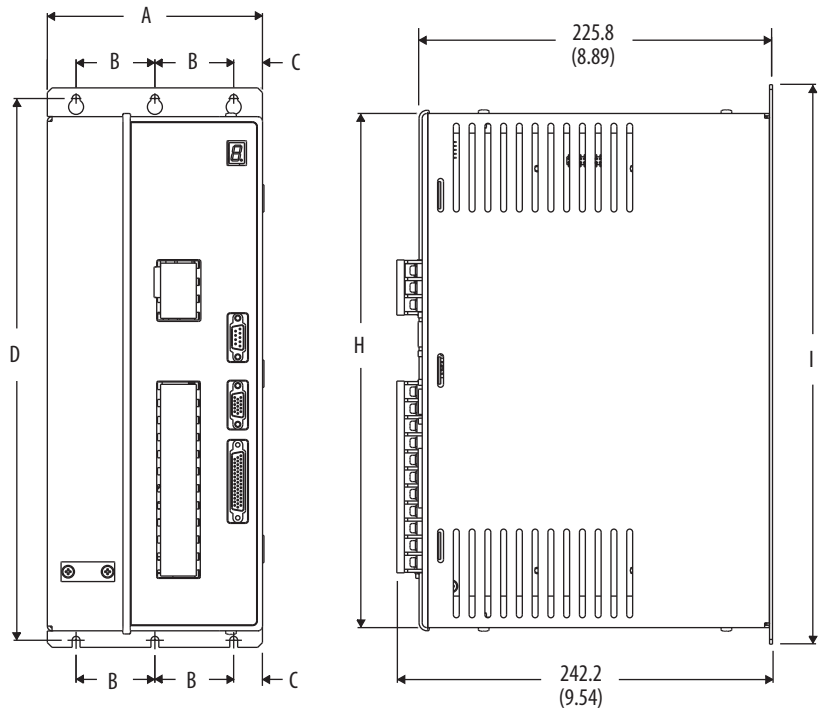
Dimensions are in mm (in.)

Unit shown is the 2098-DSD-030.

Ultra3000 Drive Cat. No.	**A** mm (in.)	**B** mm (in.)	**C** mm (in.)	**J** mm (in.)
2098-DSD-030, 2098-DSD-030X, 2098-DSD-030-SE, 2098-DSD-030-DN, 2098-DSD-030X-DN	91.44 (3.6)	50.8 (2.0)	20.32 (0.8)	243.84 (9.6)
2098-DSD-075, 2098-DSD-075X, 2098-DSD-075-SE, 2098-DSD-075-DN, 2098-DSD-075X-DN	138.68 (5.41)	88.9 (3.5)	24.89 (0.96)	247.14 (9.73)
2098-DSD-150, 2098-DSD-150X, 2098-DSD-150-SE, 2098-DSD-150-DN, 2098-DSD-150X-DN	188.97 (7.44)	139.7 (5.5)	24.6 (0.97)	241.05 (9.49)

In this figure, *xxx* is replaced by 030, 050, 100, 150, or 220 to represent the Ultra3000 3, 5, 10, 15, and 22 kW drives respectively.

2098-DSD-HV*xxx*, 2098-DSD-HV*xxx*X, 2098-DSD-HV*xxx*-SE, 2098-DSD-HV*xxx*-DN, 2098-DSD-HV*xxx*X-DN Dimensions



Dimensions are in mm (in.)

Unit shown is the 2098-DSD-HV030.

Ultra3000 Drives (1) **Cat. No.**	**A** mm (in.)	**C** mm (in.)	**B** mm (in.)	**D** mm (in.)	**H** mm (in.)	**I** mm (in.)
2098-DSD-HV030*x*, 2098-DSD-HV030-*xx*, 2098-DSD-HV050*x*, 2098-DSD-HV050-*xx*	138.7 5.46)	18.5 (0.73)	50.8 (2.0)	349.3 (13.75)	331.5 (13.05)	360.7 (14.2)
2098-DSD-HV100*x*, 2098-DSD-HV100-*xx*, 2098-DSD-HV150*x*, 2098-DSD-HV150-*xx*	151.6 (5.97)	25 (0.99)				
2098-DSD-HV220*x*, 2098-DSD-HV220-*xx*	203.2 (8.0)	25.4 (1.0)	76.2 (3.0)	380.4 (14.98)	362.6 14.26)	391.8 (15.43)

(1) The *x* represents the indexing (X) option. The *-xx* represents the sercos interface (SE) or DeviceNet interface (DN) option. Sercos interface is not available with the DeviceNet interface option.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Kinetix Motion Control Selection Guide, publication GMC-SG001	Overview of Kinetix servo drives, motors, actuators, and motion accessories designed to help make initial decisions for the motion control products best suited for your system requirements.
Kinetix Rotary Motion Specifications, publication GMC-TD001	Product specifications for MP-Series™ (Bulletin MPL, MPM, MPF, MPS), Kinetix 6000M (Bulletin MDF), TL-Series, RDD-Series™, and HPK-Series™ rotary motors.
Kinetix Linear Motion Specifications, publication GMC-TD002	Product specifications for Bulletin MPAS and MPMA linear stages, Bulletin MPAR, MPAI, and TLAR electric cylinders, and LDC-Series and LDL-Series linear motors.
Kinetix Motion Accessories Specifications, publication GMC-TD004	Product specifications for Bulletin 2090 motor and interface cables, low-profile connector kits, drive power components, and other servo drive accessory items.
Kinetix 6000 and Kinetix 6200/6500 Drive Systems, publication GMC-RM003	System design guide to determine and select the required (drive specific) drive module, power accessory, connector kit, motor cable, and interface cable catalog numbers for your drive and motor/actuator motion control system. Included are system performance specifications and torque/speed curves (rotary motion) and force/velocity curves (linear motion) for your motion application.
Kinetix 300/350 Drive Systems, publication GMC-RM004	
Kinetix 3 Drive Systems, publication GMC-RM005	
Kinetix 2000 Drive Systems, publication GMC-RM006	
Kinetix 7000 Drive Systems, publication GMC-RM007	
Ultra3000 Drive Systems, publication GMC-RM008	
Kinetix 6200 and Kinetix 6500 Safe Speed Monitoring Servo Drives Safety Reference Manual, publication 2094-RM001	Information on wiring, configuring, and troubleshooting the safe-speed features of your Kinetix 6200 and Kinetix 6500 drives.
Kinetix 6200 and Kinetix 6500 Safe Torque-off Servo Drives Safety Reference Manual, publication 2094-RM002	Information on wiring, configuring, and troubleshooting the safe torque-off features of your Kinetix 6200 and Kinetix 6500 drives.
Kinetix Safe-off Feature Safety Reference Manual, publication GMC-RM002	Information on wiring and troubleshooting your Kinetix 6000 and Kinetix 7000 servo drives with the safe-off feature.
System Design for Control of Electrical Noise Reference Manual, publication GMC-RM001	Information, examples, and techniques designed to minimize system failures caused by electrical noise.
EMC Noise Management DVD, publication GMC-SP004	
ControlLogix Selection Guide, publication 1756-SG001	Information to determine which ControlLogix controller fits your application and the product specifications to help design a ControlLogix system and select the appropriate components.
CompactLogix Selection Guide, publication 1769-SG001	Information to determine which CompactLogix controller fits your application and the product specifications to help design a CompactLogix system and select the appropriate components.
Integrated Architecture Recommended Literature Reference Manual, publication IASIMP-RM001	This document provides lists of technical publications for Integrated Architecture™ products. These lists are not all-inclusive, but they do include the most-commonly accessed publications for the related products.
Industrial Ethernet Media Brochure, publication 1585-BR001	Information to determine which Bulletin 1585 Ethernet cable fits your application and the product specifications to help select the appropriate components.
Motion Analyzer software download from http://www.ab.com/motion/software/analyzer.html	Comprehensive motion application sizing tool used for analysis, optimization, selection, and validation of your Kinetix Motion Control system.
Rockwell Automation Configuration and Selection Tools, website http://www.ab.com	Online product selection and system configuration tools, including AutoCad (DXF) drawings.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation® sales representative.

Important Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

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Publication GMC-TD003B-EN-P - August 2012
Supersedes Publication GMC-TD003A-EN-P - September 2011

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